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No. CLXV.

165-173

A MISCELLANY IN HONOR
OF
MERRITT LYNDON FERNALD

PUBLISHED BY
THE GRAY HERBARIUM OF HARVARD UNIVERSITY
CAMBRIDGE, MASS., U. S. A.
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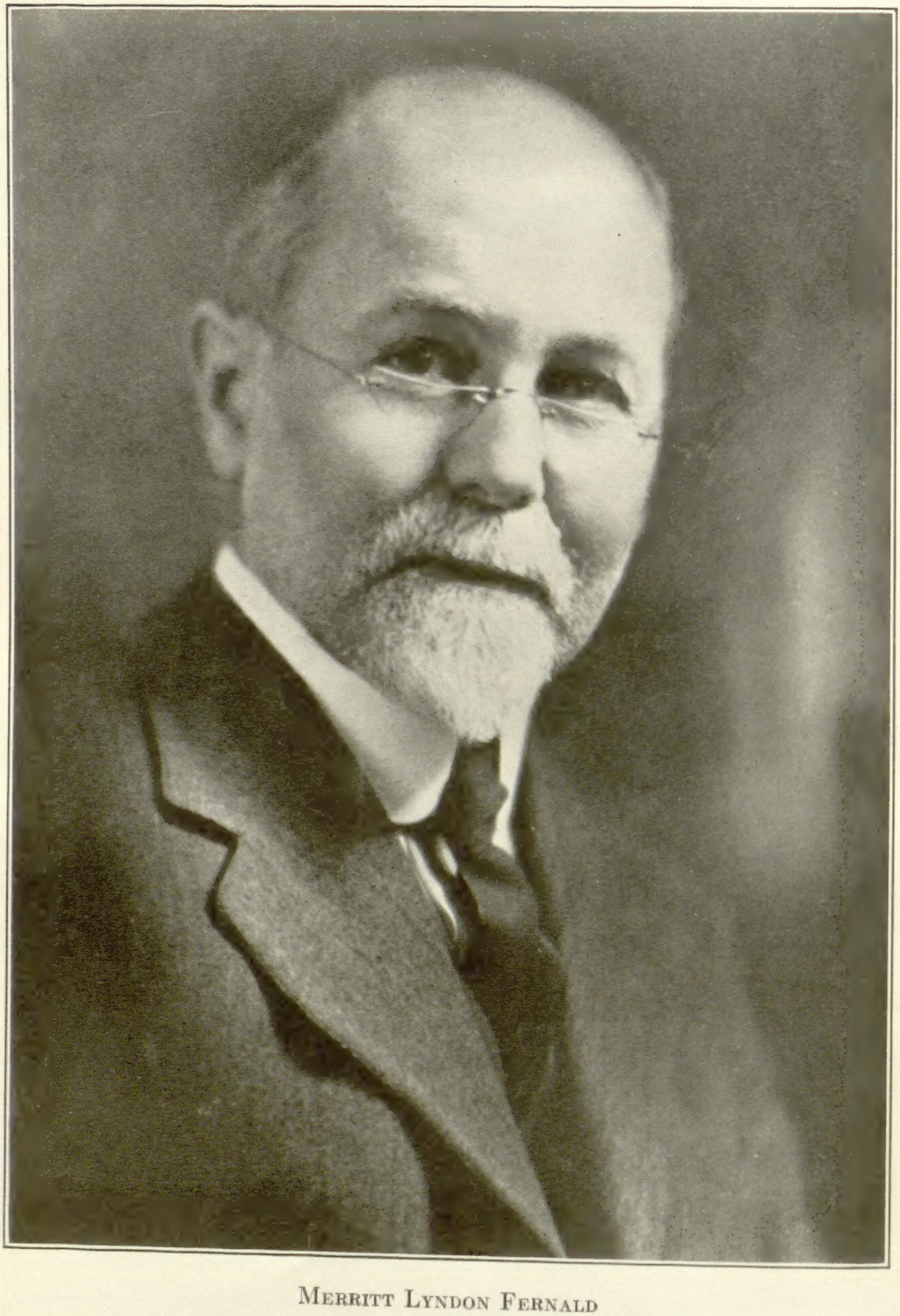


MERRITT LYNDON FERNALD

On June 30, 1947, after more than fifty years at Harvard University as museum officer, teacher and investigator, Merritt Lyndon Fernald retired as Fisher Professor of Natural History and Director of the Gray Herbarium. In recognition of his long service and of his distinguished contributions to knowledge of the flora of North America and its significance, the staff of the Gray Herbarium dedicates to him this Contribution, written by former students, associates and colleagues at other institutions.

THE GOUANE PALM OF HAITI

By L. H. Bailey

On September 18, 1926, the Swedish collector Ekman found a palm in southern Haiti called Gouane by the natives. In 1929 the palm was carefully published by Max Burret as *Coccothrinax Ekmanii*, with detailed plate illustrations, in Kungl. Svenska Vetenskapsakademiens Handlingar, Stockholm, 3rd series, Band 6, number 7. Later I saw his specimens at Damien, Port-au-Prince, Haiti, and doubted whether the plant is properly a Coccothrinax. I wanted to study the palm from fresh material but in two expeditions to Haiti was not successful in finding it: in December, 1946, however, I was able to obtain the palm from its native habitat, in good condition and in flower and mature fruit, with photographs, and I am now ready to record my conviction in print. In this attempt I am clarifying the genus *Coccothrinax*, a process I began eight years ago with the separation of *Zombia* (Gent. Herb. iv, 239).

Erik Leonard Ekman, 1883–1931, was an ardent and triumphant collector of plants in Cuba and Hispaniola. He went native in his collecting, reaching places far from roads and trails, speaking the languages and dialects, living on foods he picked up on his way. He is keenly remembered in the three countries where he collected: two portraits of him appear in Hermano León's recent Flora de Cuba; another one is in Moscoso's Catalogus Floræ Domingensis, where an excellent account of his work is published, and an appreciative remembrance is in the Preface to Barker & Dardeau, Flora d'Haiti, 1930. He died in Santiago de los Caballeros, Dominican Republic, January 15, 1931, and there his mortal remains rested. Comment on him in Journal of Botany (London), volume 69, states that "this Swedish botanist" died at the age of 48. "With the aid of a small Fellowship for study abroad, after obtaining his Ph.D. for a botanical thesis in 1914, Dr. Ekman had spent seventeen years in botanical exploration in Cuba and Haiti, during which he sent very large collections to the Swedish State Museum of Science." Ekman's name is associated with many species of plants, as well as with four genera, Ekmania of the Compositæ, Ekmanochloa of the Gramineæ, Ekmaniocharis of the Melastomaceæ, Ekmanianthe of the Bignoniaceæ. Pl. 1 shows him afield with pack front and back, machete, but little indication of food or drink.

Fig. 1. HAITIELLA EKMANII in its native habit in Haiti. Mature verrucose fruits, about one-third oversize.

HAITIELLA, gen. nov. Palmacearum, tribus Thrinacearum.

Flores hermaphroditi, valde parvi, sessiles, vulgo 6-meri; perianthium circa 1 mm. diam., cupulatum basi, profunde partitum in 6 lobos acutos serius angustissimos cum mortui et sicci, bracteis squamiformibus subtentum; stamina 6, valde exserta, antheræ oblongæ dorsifixæ; stylus 1, gracilis, antheras superans, curvus apice, stigma parvum obliquumque; ovarium unicum et simplex: fructus depresso-globosi, 5–7 mm. diam. cum sicci, fulvi, verrucosi vel parvis punctis editis obsiti, quæ in senioribus plus vel minus evanescent, stylus primo persistens prominensque sed caducus ætate exacta, embryon laterale; nucula divisa, plus vel minus omnino in 3–5 partes, lineæ divisionis evidentes, in albumine quod aliter homogeneum est: inflorescentia in parvis simplicibus paniculiformibus racemis 10–12 cm. longis ex axilla gracilium, carinatarum, acutarum spathillarum 12–14 cm. longarum, circa 6 spathillæ in unam multiplicem spatham 40–50 cm. longam conjunctæ, ex axilla laxæ reticulatæ anastomoticæ conspicuæ vaginæ orientem: erecta parva arbor, truncus unicus et obsitus laxis, clathratis reticulatis intertextis cylindris, liberis spiniformibus apicibus in contrarias partes extendentes: folia palmata, erecta, rigida, non divaricata nec declinata nec librata, palman non expandens. Differt a Coccothrinace profundius inciso perianthio, stylo exserto, fructu multo minus divisa, albumine non ruminato, arbore aspectu alio, foliis erectis, divisionibus stricte compactis, palmane non expandente nec librato nec declinato vel plano, trunco obsito clathratis reticulatis cylindricis vaginis ex quibus plurimæ sunt petioliferæ liberis spiniformibus apicalibus obliquis projectionibus.

Haitiella Ekmanii (Burret), stat. nov. GOUANE of Haiti. Figs. 1–3. Pl. 2.

Coccothrinax Ekmanii, Burret, in Kungl. Svensk. Vetens. Handl. vi, 11, Stockholm 1929, tab. 4.

Small erect tree 3–6 m. tall, known from only one locality in Haiti, difficult of access, apparently not in cultivation: trunk single, slender, 7–8 cm. diam., covered completely at first with woven cylindric leaf-sheaths (Pl. 2) but becoming bare and lightly ringed on the lower part: leaves palmate, blade 30–40 cm. long, narrow because the folds are pressed together laterally, grayish or silvery, glossy when fresh, very thinly pubescent at least on upward folds, hastula short and pointed at middle (Fig. 2), whole leaf standing stiffly upright or erect; petiole slender, unarmed unless at very base, edges sharp: flower-clusters axillary, 25–35 cm. long, approximately equalling the petiole, comprised of 3–6 lateral fascicles: fruits many in the combined clusters, greenish-yellow becoming tawny when dry, contrasts shown in Fig. 3.

Anses-à-Pitre on Morne Savane Lafleur on the road to Ravine Tresór, Haiti Ouest, *Ekman 6991*, *Bailey 383* entering from Massif de la Selle. It is fairly abundant at its habitat, which is

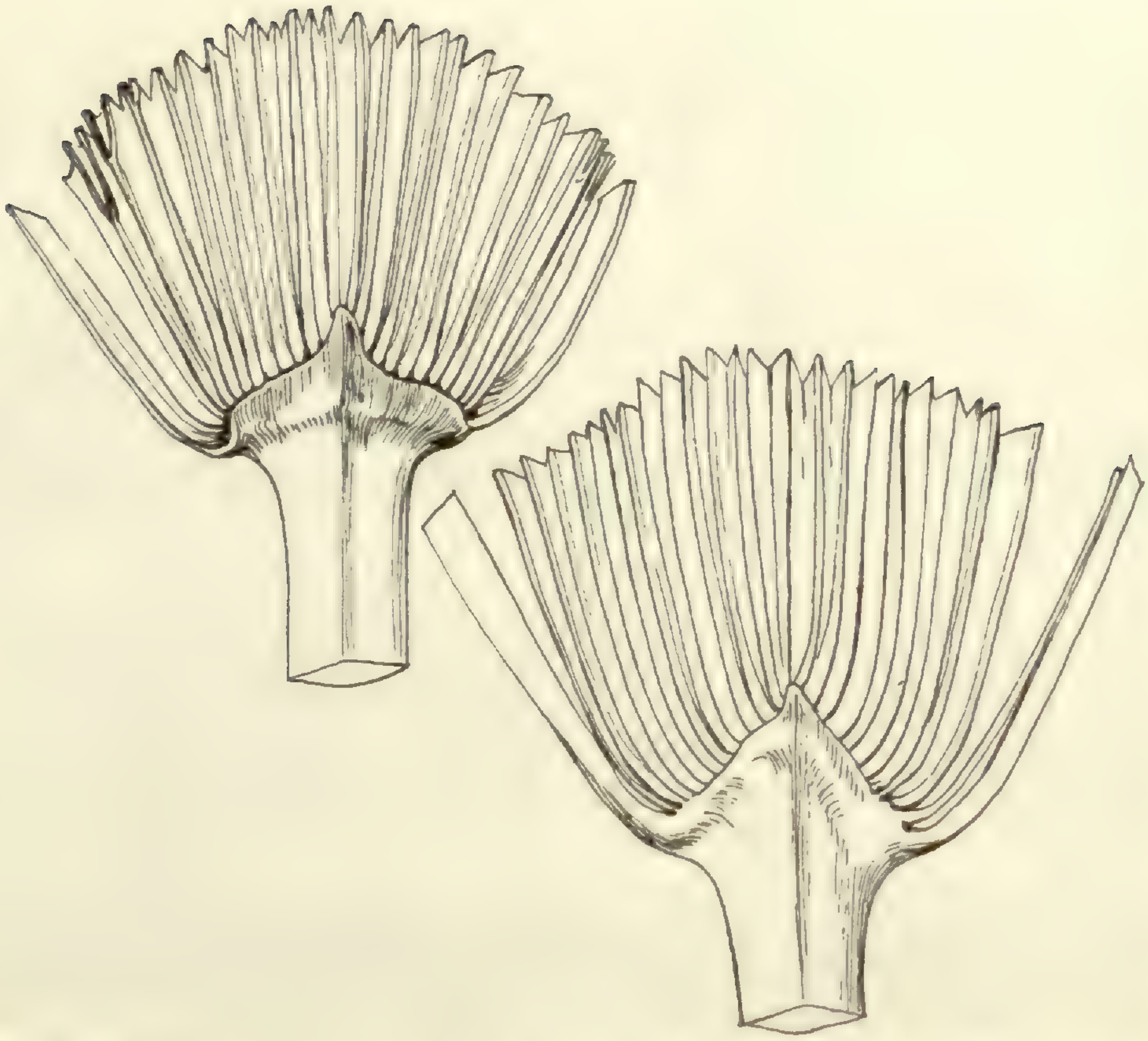


Fig. 2. HASTULA, front and rear views, of *Haitiella Ekmanii;* natural size.

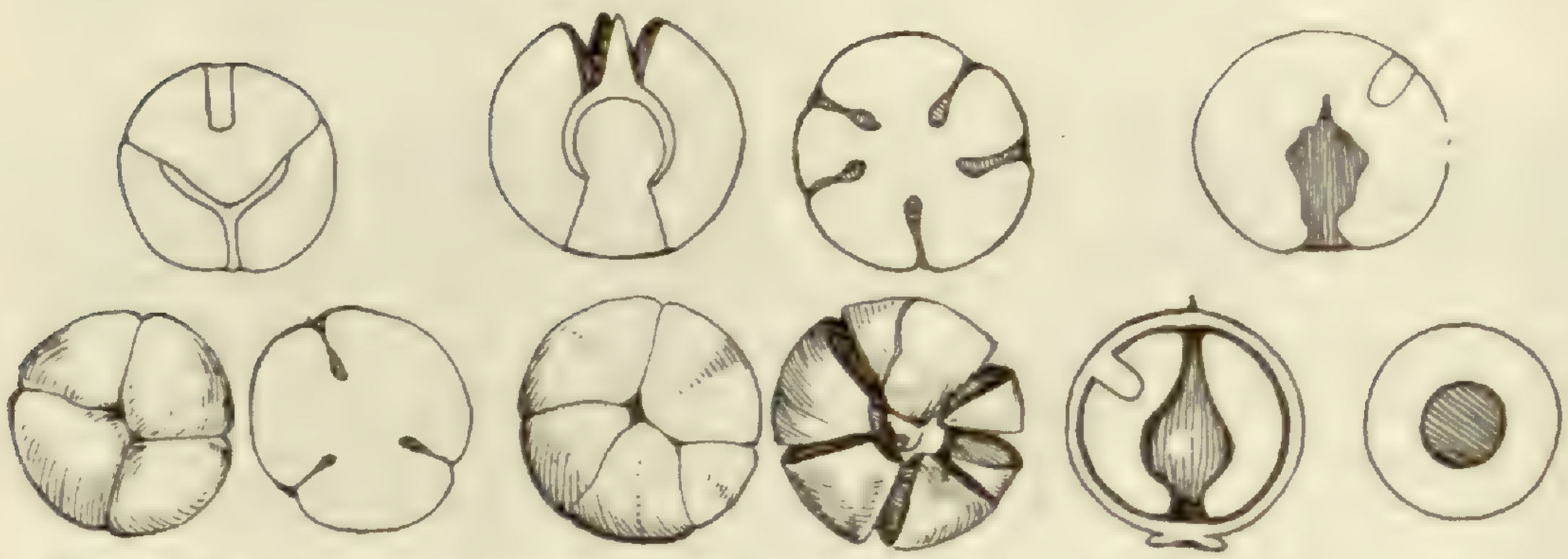
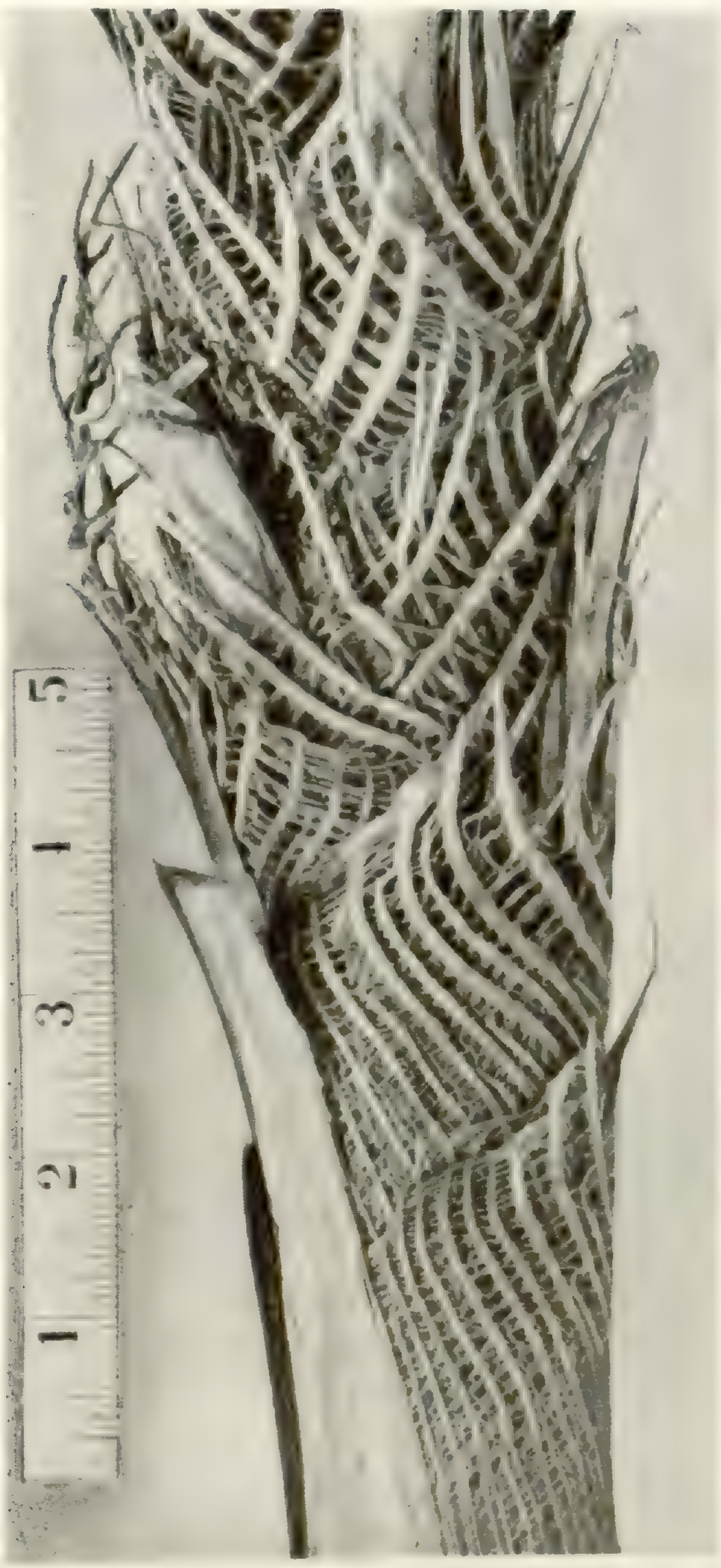


Fig. 3. NUTLETS OF THREE palms, twice or more natural size. Three left, *Haitiella;* upper one longitudinal section; lower right, cross section. Middle four; upper left, *Haitiella* longitudinal section; remaining three *Coccothrinax.* Right three, *Thrinax,* all showing centralium, lower right cross section, others longitudinal sections.

ERIK LEONARD EKMAN, afield in the Antilles.



LATTICED PETIOLAR SHEATHS, removable as cylinders.

25–30 feet above the Caribbean shore. It grows on lime rock without a trace of surface soil. Whether young or old, the trees have a stiff and dry appearance, the leaves erect. The leaves are employed by the natives for the making of a large hat called "gouane", but whether this vernacular applies primarily to the hat or the palm, or to both indifferently, is not determined.

I must not close this narrative of the Gouane palm without expressing my great obligation to M. Félix Pierre-Louis of the botanical department, Services du Département de l'Agriculture, Damien, who led the horse-back search for the palm for two or three days from the crown of the Massif at about 6000 feet, and who has supplied me with much of the information herein recorded.

Bailey Hortorium, Cornell University.

TWO NEW FORMS OF RHODODENDRON ROSEUM

By Alfred Rehder

Rhododendron roseum is apparently one of the rather variable species of American Azaleas, of which, so far, no forms nor variations have been described. In most American floras and publications, this species had been confused with other related species, chiefly with *R. canescens* (Michx.) Sweet and *R. nudiflorum* (L.) Torrey. It therefore seems to be not amiss to give below the synonymy of this species which ranges from southern Quebec and New Hampshire to southeastern Missouri, Tennessee and Virginia. For additional citations of literature, see Rehder, l. c. (1921).

Rhododendron roseum (Loisel.) Rehder in Wilson & Rehder, Monog. Azaleas, 138 (1921).

Azalea rosea Loiseleur in Duhamel, Traité Arb. Arbust. éd. augm. [Nouv. Duhamel] **5:** 224, t. 64 (1812).

Azalea canescens Pursh, Fl. Am. Sept. **1:** 152 (1814) in part as to the plant from Virginia; not Michaux (1803).

Azalea nudiflora ɛɛ. *rosea* Sweet, Hort. Brit. 265 (1826), nom. nud.

Azalea nudiflora sensu Darlington, Fl. Cestr. 26 (1826); not Linnaeus (1762).

Rhododendron nudiflorum ɛɛ. *roseum* Sweet, Hort. Brit. ed. 2, 344 (1830), nom. nud.

Rhododendron nudiflorum sensu Darlington, Fl. Cestr. ed. 2, 262 (1837), not Torrey (1824).

Rhododendron canescens sensu Porter in Bull. Torrey Bot. Club, **16:** 220 (1889), not Sweet (1830).
Azalea prinophylla Small in N. Am. Fl. **29:** 42 (1914).
Rhododendron prinophyllum Millais, Rhododendron, 229 (1917).
Rhododendron nudiflorum var. *roseum* Wiegand in Rhodora, **26:** 4 (1924)

RHODODENDRON ROSEUM forma **lutescens,** forma nova. A typo recedit corollae colore, limbo pallide luteo, lobo superiore intus intensius luteo, ceteris pallide luteis et plus minusve leviter colore pallide roseo suffusis, extus costa media rosea notatis, tubo coccineo. Folia elliptica, 4–6 cm. longa, supra minute puberula vel fere glabra, subtus in facie sparse, ad costam et venas densius villosa.

CULTIVATED SPECIMENS: Arnold Arboretum, no. 248–46, May and Sept. 2, 1946 and May 19, 1947, coll. *A. Rehder,* TYPE in herb. Arnold Arb. (plant received from J. B. Gable, Stewartstown, Pa., May, 1946).

This form agrees well with typical *R. roseum,* but differs in the pale yellow color of the limb of the corolla while the tube is bright red. According to the color charts published by the British Colour Council in collaboration with the Royal Horticultural Society, the color of the limb is "Maize yellow (607/1)" and of the tube "Signal Red (119/3)." In the group of the species with pink to white flowers, namely *R. nudiflorum* (L.) Torrey, *R. roseum* (Loisel.) Rehder, *R. alabamense* Rehder, *R. canescens* (Michx.) Sweet and *R. atlanticum* (Ashe) Rehder, the only form which might be considered a counterpart of this form is *R. atlanticum* f. *luteo-album* (Coker) Rehder; the yellow color is very faint and only clearly noticeable in the bud.

Rhododendron roseum forma *lutescens* was discovered some time before 1927 by Mr. Joseph B. Gable of Stewartstown, Pennsylvania, in the woods near that town, in a number of plants showing the yellow coloring in various degrees; one of the most distinctly yellow was transplanted to his nursery and later, in the spring of 1946, was sent to the Arnold Arboretum where it flowered well in 1946 and 1947.

RHODODENDRON ROSEUM forma **plenum,** forma nova. A typo recedit floribus plenis, i. e. staminibus in staminodia 6–8 oblongo-lanceolata 5–8 mm. lata mutatis.

CULTIVATED SPECIMEN: garden of Roland H. P. Jacobus, 54 Avenue A, Turners Falls, Massachusetts, originally found wild in the neighboring woods; specimen sent in 1936 (Herb. Arnold Arb.).

This double-flowered form of *R. roseum* has the stamens changed into 6–8 oblong-lanceolate pink staminodes with 1–3 sterile stamens or none at all. It was discovered by the late Roland H. P. Jacobus sometime before 1935 near Turners Falls

on the fringe of neighboring woods and transplanted to his garden. A plant sent to the Arnold Arboretum in 1936 unfortunately did not live.

In his letter of October 28, 1946, Mr. Joseph B. Gable states that about twenty years ago he collected a plant of *R. nudiflorum* with a number of double flowers. He transferred the plant to his nursery where it is still growing. Most of the flowers are normal or have only some of the stamens distorted or partly petaloid; only a small percentage appearing at the end of the normal flowering season are fully double.

Double-flowered forms growing wild have been found in quite a number of genera. In the genus Rhododendron double-flowered forms have been found of *R. roseum* and *R. nudiflorum* (L.) Torrey and in at least four other species, namely in *R. linearifolium* Sieb. & Zucc., *R. yedoense* Maxim., *R. albiflorum* Hook. and *R. ferrugineum* L. Of *R. linearifolium*, Wilson in Wilson & Rehder, Monogr. Azaleas, 76 (1921) reports the finding wild in the pine woods of Futagawa, Hondo, Japan, of one or two plants of forma *dianthiflorum* (Carr.) Wils. Of the double-flowered *R. yedoense* Maxim., of which the phylogenetic type is *R. y.* var. *poukhanense* (Lévl.) Nakai, Wilson in op. cit. 65 (1921) states that his Korean specimens came from a plant found not far from Mount Poukhan. Of *R. albiflorum* Hook. a double-flowered form was found by J. G. Jack and myself near Glacier in British Colombia (see Bot. Gaz. **43:** 281 (1906) and Mitt. Deutsch. Dendr. Ges. **1907** (16)**:** 75 [1908]). Of *R. ferrugineum* L. a double-flowered form was found in southern Tirol near Trafoi in great quantity by A. Kerner (see Oester. Bot. Zeitschr. **15:** 286 (1865)).

Among cultivated Rhododendrons, particularly of the subgenus *Anthodendron* (Azalea) numerous double-flowered forms, partly hybrids, are known and much cultivated, while the large subgenus *Eurhododendron* has produced only a few double-flowered forms. The best known is probably a form called "*R. robustissimum fastuosum fl. pleno*" which belongs to *R. Morelianum* Lemaire (*R. catawbiense* × *ponticum*).

Arnold Arboretum, Harvard University.

NOTES ON THE "HISTORICAL FACTOR" IN PLANT GEOGRAPHY

By Robert E. Woodson, Jr.

In one of the most stimulating phytogeographic essays of recent years. H. L. Mason (1946) discusses very helpfully three aspects of problems involving the distribution of plants. They are, firstly, the "intensity spans of the various environmental factors or . . . conditions or sequences of conditions of these factors;" secondly, the physiological reactions of the individual plant to these conditions or sequences of conditions; and thirdly, the genetic processes which determine such reactions. The discussion loses value for me, however, in the rather provocative insistence of the author that these three factors alone are worthy of serious attention in accounting for the present distribution of plants, and that all others, including the historical, are "attempts to apply abstract ideas in the role of factors in cause-and-effect relationships [p. 209]." "The phrase 'historical factor' is often applied to problems of restricted distribution. This is a vague way of implying that age is a significant factor or attribute of endemism, as well as a phrase with which one may confuse facts attendant upon migration and establishment with facts pertaining to restriction of range [p. 223]." "The size and shape of the area occupied are the product of today's facts, both genetic and environmental. Area as such has no historical significance in vegetation [p. 224]."

It hardly appears necessary, in a volume dedicated to Merritt Lyndon Fernald, to defend the general application of the "historical factor" in plant geography. However I shall take this opportunity to discuss rather briefly some relations of paleogeography to the present distribution of the species of *Asclepias* in eastern North America, by which I intend those species naturally occurring wholly or predominantly east of the 100th meridian.

It is recognized generally that many of the principal families of flowering plants were established by the close of the Mesozoic era, possibly before the Lower Cretaceous. Although I know of no indubitable fossil remains of *Asclepias*, Berry (1913) has assigned certain leaf impressions of the Lower Crestaceous to the modern genus *Acerates*, which I include within *Asclepias*, and numerous records of Cretaceous and early Cenozoic imprints of the form genus *Apocynophyllum* are known (La Motte, 1944). These may well represent at least in part ancestors of our modern

milkweeds, if not records of extant species. Still more convincing are the well preserved seeds (including the silky coma) assigned to the Asclepiadaceae or the Apocynaceae by Reid and Chandler (1926) in their study of the Oligocene Bembridge beds of the Isle of Wight. At any rate, present distributions of many species of *Asclepias* correspond so closely to what is known of Cretaceous geography, as we shall see, that I feel we may hypothesize rather safely much the same speciation in those times as that with which we are familiar at present.

The Cretaceous has been called "the age of greatest submergence of the continents and the most extensive epeiric seas the Earth has known (Schuchert and Dunbar, 1933)." The complex submergences and resulting isolation of floras probably were of the utmost importance to the meteoric evolutiônary diversification of angiosperms during that time, and still are reflected in present speciation. Late Cretaceous saw the climax of the dissection of North America with the submergence of the Rocky Mountain trough from the Caribbean to the Arctic. This was accompanied by submergence of the southeastern coastal plain, particularly north of the Gulf of Mexico, a deep embayment extending up the Mississippi valley as far as southern Illinois. This embayment separated the ancient Appalachian and Ozark uplands, including the extension of the latter to the Llano uplift in north-central Texas, and is recalled in our present vegetation by numerous disjunct and vicarious species and subspecies.

The importance of Appalachia and Ozarkia as plant refuges long has been appreciated. It is my belief that a third somewhat similar refuge existed in Tertiary times in what is now northern Florida, since certain aspects of my research upon *Asclepias* can scarcely be explained without assuming its presence. The vegetation of Florida is one of the most intriguing in the world, and its high endemism cannot be understood, in my opinion, simply as a convergence of waifs from older lands to north and south.

The peninsula of Florida, according to Vaughan (1910), owes its origin to a fold of the ocean bottom connected in some way with the Piedmont of central Georgia. Northern Florida, he believed, was positive and above sea level throughout the Paleozoic and into Upper Cretaceous time. It then began to subside, but no faster than the sediments accumulated. From time to time the peninsula would emerge a little above sea level in the form of low islands, only again to be submerged. The area, in effect, was a shallow submarine bank with fluctuating islands

having much the same relation to the continent as has the Bahama archipelago to the peninsula of the present time.

I am indebted to Dr. R. B. Campbell for a letter in which he outlines some unpublished data on the geological history of Florida. That Floridian islands existed during Eocene is indicated by the absence of Upper Eocene (Ocala limestone) in three areas of the peninsula: in portions of Levy and Citrus counties, Seminole and Orange counties, and Dade and Broward counties. Upper Middle Eocene is absent in wells of adjacent parts of Hamilton, Suwanee, and Columbia counties. Dr. Campbell states that other than as noted above there is a complete section of the pre-Ocala to the bottom of the Upper Cretaceous. "However, in the northern part of the state, which might be called the continental part in contrast to the peninsula, these deposits are predominantly clastic and would indicate comparatively shallow waters. I think that that condition would make it possible to have had islands of asylum all during this period."

During early Oligocene most of Florida was elevated as a very large island cut off from the continent by a seaway extending from the Gulf of Mexico to the Atlantic and known to geologists as Suwanee Strait; it is represented today by the basins of the Okeefenokee and Suwanee swamps. This island was christened "Orange Island" by Vaughan (loc. cit.), and although it apparently fluctuated in area, it persisted until its final union to the continent as a peninsula.

Biological evidence of the Cenozoic Floridian archipelago, to which I shall henceforth refer merely as Orange Island, was found as early as 1890 by Dall (1890–1903), who described numerous land as well as fresh and brackish water species of shell fossils from the Tampa limestone (Lower Miocene). According to Dickerson and Campbell (Campbell, 1940), Dall's shells are so highly distinctive that they cannot be regarded as accidental waifs, and the assumption is made that they were the result of autochthonous development upon several or numerous islands, the outlines of which may one day be mapped from increasing fossil records.

I would prefer to believe in the existence of a fluctuating island refuge in Florida since Paleozoic times, not only upon the basis of the data on *Asclepias* which will follow, but because of such sphinx-like relicts as *Torreya taxifolia* which otherwise must be assumed to have migrated to the area in rather recent times. On the other hand, assuming with the stratigraphic evidence that Orange Island could have existed only from Eocene to Pliocene,

the degree of endemism which might be produced from a mixed waif colonization through isolation in that interval may be appreciated by considering the approximately 15% endemism of the present spermatophytes of the post-Pleistocene Bahama islands (Britton and Millspaugh, 1920).

Withdrawal of the Cretaceous seas during the early Cenozoic effected the reunion of the Appalachian and Ozarkian peninsulas in Oligocene, and of emergent Orange Island to the continent in Pliocene. In Pleistocene, however, Appalachia and Ozarkia again were partially disjuncted, this time from the north; the continental ice sheets ranged approximately to the present valleys of the Missouri and Ohio rivers, roughly to the head of the Mississippi embayment of Cretaceous and early Cenozoic times. Events such as these scarcely can be ignored by the dynamic plant geographer, nor by the population geneticist; they are summarized by the composite Map 1.

We may begin our discussion of distribution in *Asclepias* most conveniently by considering *A. tuberosa*, the familiar orange or yellow flowered butterflyweed. I have been investigating the population dynamics of this species for several years, chiefly from the standpoint of biometry; the statistical support of the generalizations which follow will be found in a more thorough account now in press (Woodson, 1947).

Asclepias tuberosa comprises three subspecies whose ranges are indicated in Map 2. A comparison with Map 1 will identify the distributions of subspecies *interior*, *tuberosa*, and *Rolfsii* with the land masses Ozarkia, Appalachia, and Orange Island, respectively. The divergent, broken lines separating the three subspecies in Map 2 are not employed simply to delimit geographic ranges; they represent approximately the mid-stream of introgressive hybridization between adjacent pairs of subspecies, for all three apparently are quite panmictic. The position of the lines has been determined in both cases by connecting artificial quadrat populations of highest variability, indicative of greatest heterozygosis. In the case of the more northern line, this "crest of variability," as I shall call it, is paralleled almost exactly by a similar crest apparently associated with hybrid vigor.

The situation is quite complex, and effective summary in a single paragraph is unsatisfactory. The data indicate quite definitely, however, that all three populations must have arisen independently and in more or less complete isolation from one another in order to effect subspeciation, since at the present time all are panmictic at the commissures of their ranges. *Rolfsii*,

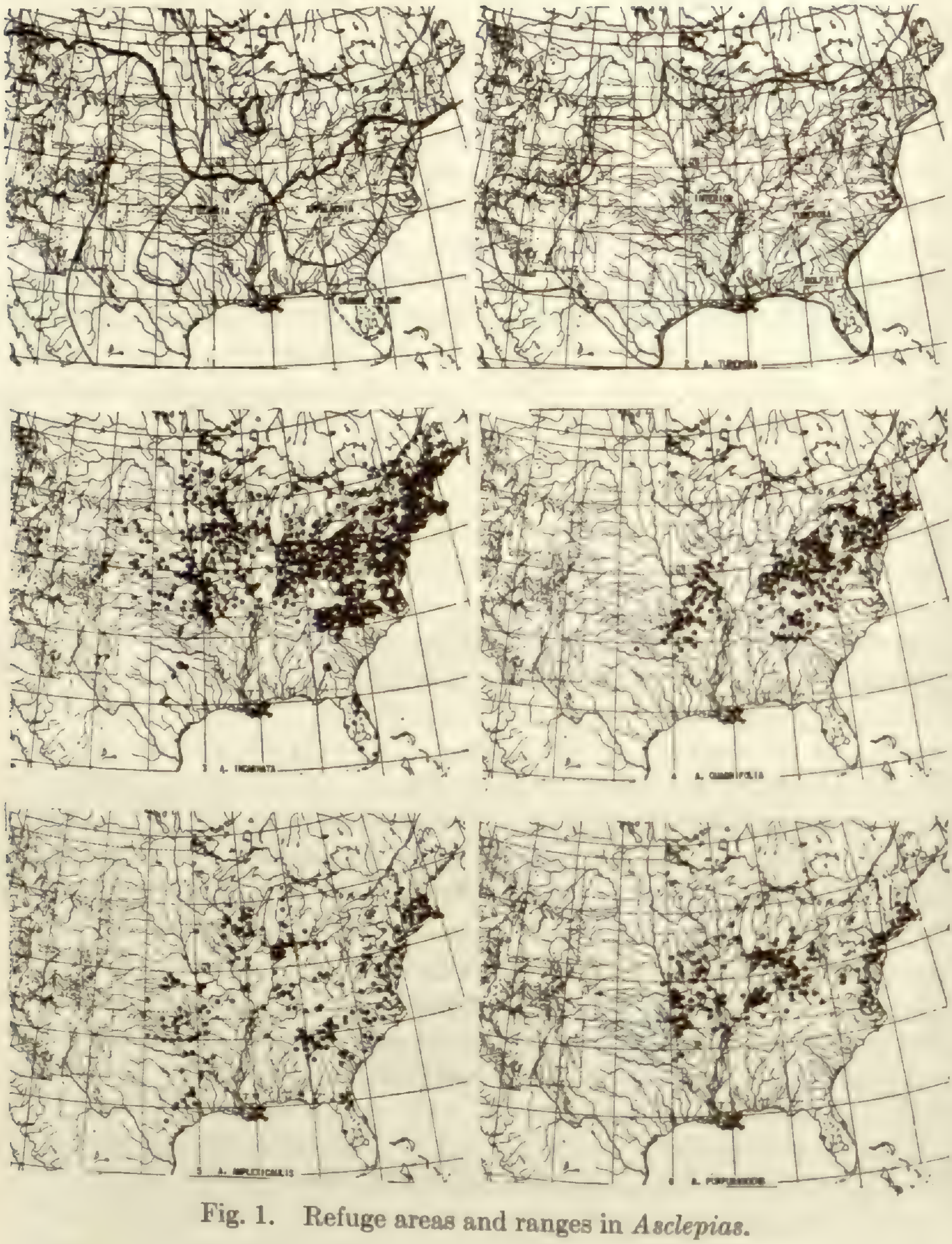


Fig. 1. Refuge areas and ranges in *Asclepias*.

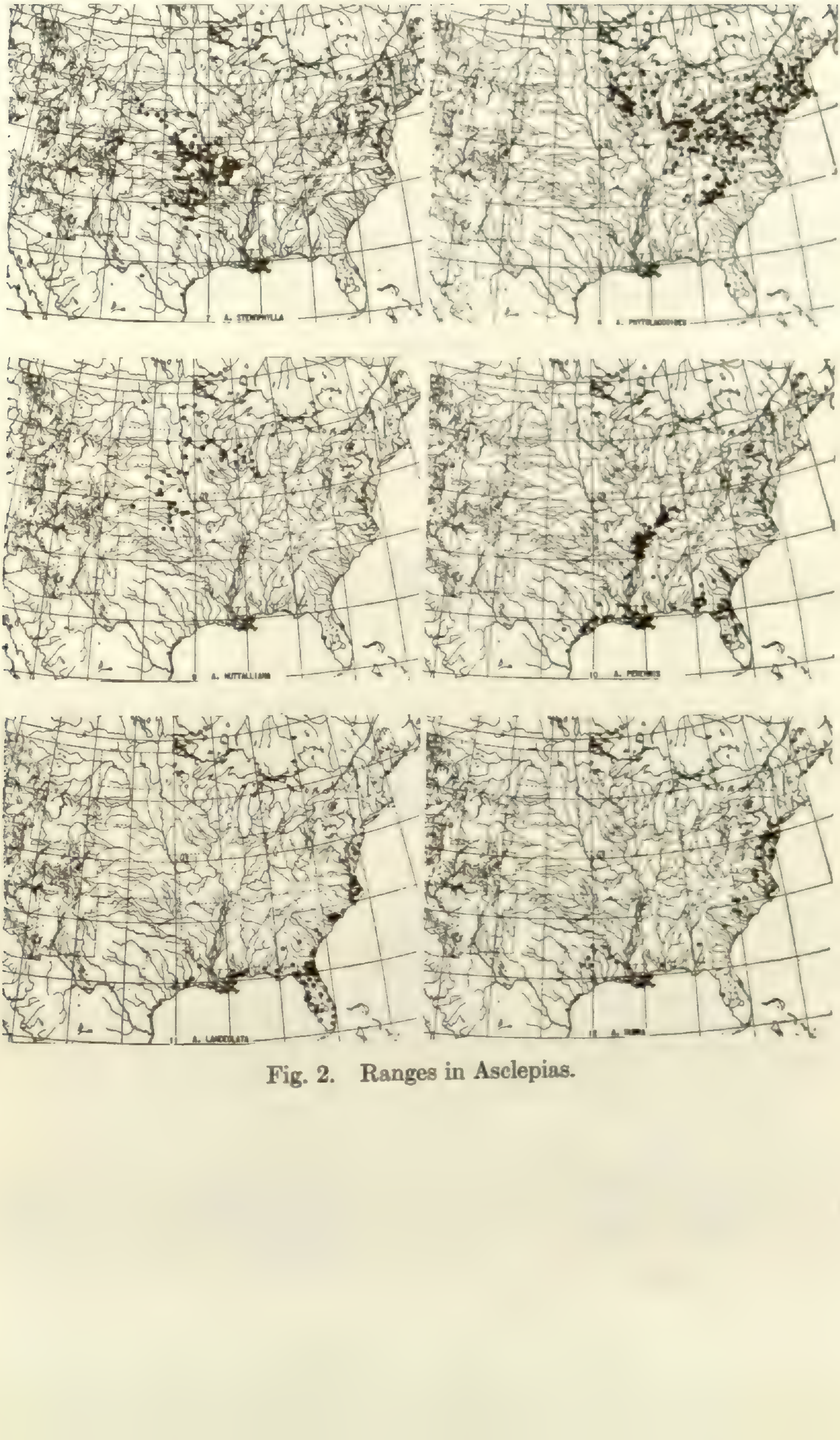


Fig. 2. Ranges in Asclepias.

surely, could not have maintained a separate existence with *tuberosa* upon the Appalachian upland, later migrating to Florida only to return in panmixy with its sister subspecies. Surely the most simple explanation is to assume that all three subspecies arose perhaps from a common ancestor through isolation in the manner suggested by Map 1. *A. t. Rolfsii*, as well as many superficially similar entities, clearly plays the role of a living index fossil testifying to the existence of a Floridian refugium of great antiquity.

Granted the premise of three Cretaceous and Tertiary refugia in eastern North America, it is rather an easy matter to refer all indigenous species of *Asclepias* to one or more in essentially equiformal manner (Hultén, 1937). They are enumerated below

APPALACHIA

Euasclepias
verticillata (§1)
incarnata ssp. *pulchra* (§1)
**perennis* (§1)
quadrifolia (§2)
syriaca (§4)
tuberosa ssp. *tuberosa* (§5)
purpurascens (§6)
amplexicaulis (§10)
**phytolaccoides* (§10)
**variegata* (§11)

Acerates
viridiflora

OZARKIA

Euasclepias
verticillata (§1)
incarnata ssp. *incarnata* (§1)
**texana* (§1)
**linearis* (§1)
quadrifolia (§2)
syriaca (§4)
**ovalifolia* (§4)
tuberosa ssp. *interior* (§5)
purpurascens (§6)
amplexicaulis (§10)
**Sullivantii* (§11)
**Meadii* (§11)
**longicornu* (§13)
**Emoryi* (§13)

Acerates
viridiflora
**hirtella*
**Nuttalliana*

Polyotus
**stenophylla*

Asclepiodora
**viridis*

ORANGE ISLAND

Asclepiodella
**cinerea*
**Feayi*

Euasclepias
verticillata (§1)
**Michauxii* (§3)
**humistrata* (§4)
tuberosa ssp. *Rolfsii* (§5)
**lanceolata* (§5)
**rubra* (§5)
**Curtissii* (§7)
amplexicaulis (§10)
**obovata* (§11)
**tomentosa* (§12)

Asclepiodora
**connivens*

Acerates
**longifolia*

Podostigma
**pedicellata*

with reference to their ancestral refuges, together with subgeneric and sectional indication of their systematic affinities. An asterisk denotes an endemic species.

From the enumeration, it appears that area-size of the putative refuge is not directly proportional to systematic diversification, as one might expect. It is worthy of note that essentially the same sections of *Eua c'epias*, the supposedly primitive subgenus, are represented in all three ancestral refuges, but that greater diversification of subgenera is found to be associated with Ozarkia and Orange Island than with Appalachia.

The following enumeration indicates those species of *Asclepias* common to all, or to two of the refuges:

APPALACHIA-OZARKIA-ORANGE ISLAND

Euasclepias

verticillata (§1) *tuberosa* (*sensu lat.*) (§5) *amplexicaulis* (§10)

APPALACHIA-OZARKIA

Euasclepias

incarnata (*sensu lat.*) (§1)
quadrifolia (§2)
syriaca (§4)
purpurascens (§6)

Acerates

viridiflora

From the foregoing it would appear that greater affinity exists between the Appalachian and Ozark *Asclepias* floras than between the former and the Floridian, which may come as something of a surprise. It is fairly well known, however, that numerous plants characteristic of the southeastern coastal plain are to be found in the Ozark, Boston, and Ouachita mountains of southern Missouri and northern Arkansas. In passing, lest it be suspected that their proximity to the tropics may account for the variety of Floridian asclepiads, I should state that in all the Antilles there are but two species of *Asclepias*, *A. curassavica* and *A. nivea*, both annuals (unlike our species), and both referable to subgen. *Euasclepias*, §1.

In the preceding enumerations it was found possible to assign the existing species of *Asclepias* to one, two, or three ancestral refuges. Descriptive reference may be made to such species by the terms monocentric, bicentric, and tricentric, respectively. We have seen that the three subspecies of *A. tuberosa* can scarcely have arisen other than through isolation upon the three refuges of Appalachia, Ozarkia, and Orange Island, in view of their behavior at the commissures of their present ranges. *A. tuberosa*, of course, is a tricentric species.

Amongst the bicentric species, *A. incarnata* (Map 3), with its two subspecies *incarnata* and *pulchra*, forms an interesting parallel to *A. tuberosa* in that isolation upon Ozarkia and Appalachia, respectively, apparently has led to subspeciation followed by reunion and introgression of the differentiated populations. Although my observations of this species have not transcended the usual herbarium methods, I am sure that biometric treatment here, as in *A. tuberosa*, would reveal a commissural crest of variability together with heterosis. In both species, it is interesting to find that it is the Ozark subspecies which is the aggressor, and that the Appalachian subspecies, confined to the east by the Atlantic, is on the verge of genetic dissolution.

In passing, I should call attention to the isolated localities of both subspecies of *A. incarnata* in Florida, Louisiana, Texas, New Mexico, Colorado, and Utah. These undoubtedly are recent ruderal populations, most obviously in the southwest where they are associated with artificial reservoirs. In consideration of the comose seeds of the genus, it is remarkable that the distributions of all species are not far more complex.

We have been speaking of vicarious subspecies. Doubtless vicarious species also have been the result of isolation upon the three refuges; but it is a very difficult task to identify them, because of the notoriously elaborate floral differences which habitually distinguish species of *Asclepias*. A very conservative estimate would yield possibly four pairs of vicarious species (none for all three refuges): these are *AA. perennis* and *texana*, for Appalachia and southwestern Ozarkia (Llano uplift), respectively; *hirtella* and *longifolia*, *Meadii* and *obovata*, and *viridis* and *connivens* for Ozarkia and Orange Island. Here, again, the affinity of the Ozarks and Florida is evident. Still another instance of the same, but without the scope of species occurring predominantly east of the 100th meridian, would be *A. tomentosa* of the southeastern coastal plain and *A. arenaria* of the midwestern plains. This affinity of the milkweeds of Florida for those of the west recalls the study of Simpson (1930), which disclosed a somewhat similar relationship of Tertiary land mammals.

That isolation alone is insufficient to produce speciation or subspeciation is seen from Map 4, illustrating the distribution of *A. quadrifolia*. The map suggests that the once continuous distribution of this species may have been interrupted by the Pleistocene ice, perhaps in addition to the Mississippi embayment, and that the species has not been sufficiently aggressive

as yet to overcome the schism. *A. quadrifolia* is an extremely distinctive species, constituting a section of subgen. *Euasclepias;* I have searched diligently but in vain for any structural peculiarity of either the Appalachian or the Ozark population. The striking uniformity of the plants suggests a low morphological as well as biotypic mutation rate as a likely explanation of its conservatism.

Amongst the milkweeds of the eastern United States we find numerous species which, judging by the shape and position of their distributions, have been disjuncted in the past without undergoing regional differentiation, and have now re-effected a continuous distribution. Such species apparently may appertain to all three refuges, or to Appalachia and Ozarkia alone. Amongst the former we find *A. verticillata* and *A. amplexicaulis* (Map. 5); amongst the latter, *A. syriaca* and *A. purpurascens* (Map 6). Perhaps *A. verticillata* really should not be included in this connection, for I have observed a slight difference in dentation of the corona hoods of the eastern and western populations, but so slight that I have not yet decided whether to dignify it by nomenclatural designations.

Of course the monocentric species of eastern American asclepiads far outnumber the polycentric, as may be seen from the enumerations on pages 18–19. When the lists are broken down, it is seen that 27% of the Appalachian species are endemic, strikingly low in contrast to 58% for Ozarkia and 80% for Orange Island. The high figure for Ozarkia is due largely to the southwestern extension to the Llano uplift where, if we were not limiting ourselves to species ranging predominantly eastward of the 100th meridian, several others would be encountered. Ozarkia probably always has been more diversified ecologically than has Appalachia, the western half in all likelihood having been open prairie as early as the Eocene (Osborn, 1910). The high percentage for Orange Island, on the other hand, probably is not due chiefly to ecological diversification, but rather to systematic diversification upon not one, but several fluctuating islands, a conclusion supported by Dall's (loc. cit.) studies of the Miocene shell fauna.

In most cases it has been an easy matter to assign each species to its putative refuge or refuges. In others, however, the distributions may not be exactly equiformal, testifying to the truth of much of Mason's emphasis upon present environmental conditions and the plant's reaction to them. Of obvious importance are spontaneous changes of local climatic and edaphic conditions

(or genetic changes of the plant's physiological reactions), as well as induced changes relative to human occupance (cf. such ruderal species as *A. incarnata* and *A. syriaca*). In most cases the change of distribution is not sufficient to result in doubt concerning the refuge to which a species pertains. In others some confusion is inevitable.

The distribution of *A. stenophylla* (Map 7) surely is Ozarkian in its inception. But from the western Ozarks, chiefly west of the Gasconade River, the species has fanned out into the plains of Kansas, Nebraska, Oklahoma, and adjoining margins of neighboring states. The species would appear to have been preadapted to a plains environment because of an early occupance upon the semi-xerophytic "bald knobs" of the western Ozarks; an environment, incidentally, which presently is being diminished by the encroaching forests. *A. stenophylla* plainly is in the act of moving out from its ancestral home.

A somewhat similar picture, but of more familiar application, is presented by *A. phytolaccoides* (Map 8). This species is fanning northward from the southern Appalachians in a manner similar to the route taken by many familiar plants, including several "typically northern" conifers, such as *Thuja occidentalis*.

Some modern species of *Asclepias* seem to have left their ancestral refuge completely. A good instance of this is *A. Nuttalliana* (Map 9), which extends in nearly a semicircle about the Ozarks, from northeastern Illinois to Kansas, possibly the goal of the tendency seen in *A. stenophylla*. A familiar distributional pattern is presented by *A. perennis* (Map 10). At first glance it might be construed as a variety of the Orange Island type were it not for the conspicuous extension toward the head of the Mississippi embayment.

I am interpreting this range as derived from Appalachia, not only following the studies of Fernald (1931), but because of the peculiar pendent pods and large naked seeds of the species, quite anomalous for the genus. The seeds, particularly, would appear to be adapted for dissemination by the waters near which the plants habitually grow, and transportation for such a distance upstream would appear unlikely. *A. perennis* would appear to be a reminder of the low, rather swampy topography of the Cumberland plateau before its Miocene elevation. Evidently identification of autochthonous Orange Island elements is subject to error, and species such as *A. perennis* and other coastal plants having relicts in the highlands (Fernald, loc. cit.; Braun, 1937) must be excluded from consideration.

A very common expansion of what I interpret as the Orange Island pattern is provided by *A. lanceolata* (Map 11), a species which requires a swampy, preferably rather brackish, site. A peculiar variant is presented by the ranges of *A. rubra* (Map 12) and *A. tomentosa*, in which the species apparently have continued to extend themselves along the Atlantic and Gulf coasts, while languishing at the putative center of origin. From such apparently incipient transads we receive the suggestion that disjunct ranges may not always be of diastrophic cause.

Finally, in connection with the departure of species from their ancestral refuges, I cannot forbear returning to *A. purpurascens* (Map 6), previously discussed as a bicentric species. An examination of the distributional pattern, obtained, like the others, from a great wealth of herbarium specimens, convinces me that the Ozark population has maintained its home grounds, while expanding principally to the north and east; the Appalachian population, on the other hand, seems to have spread much less, principally to the northeast in a characteristic manner, while becoming virtually extinct in the ancestral upland. From this we may infer that some supposedly monocentric species may previously have been polycentric.

I have composed this little sketch of the distribution of *Asclepias* in the eastern United States as an example of what I consider to be a wholly justified use of the 'historical factor' in plant geography. While recognizing the value of physiological ecology, biometry, and cytogenetics, I must insist that the size and shape of the area occupied by plants of our time are the product of *yesterday's and today's* facts, both genetic and environmental. If the study of evolution has taught us anything, it is that the past is the key to the present, and the present that to the past.

Summary

Three major refuges were available to the biota of the southeastern United States during the late Mesozoic and early Cenozoic: Paleozoic Ozarkia and Appalachia, and Orange Island, rather a fluctuating archipelago in what is now the state of Florida. Present stratigraphic evidence of Orange Island extends no earlier than Eocene, but the biological evidence perhaps would favor at least oscillating emergence since earlier times.

Upon these three centers the modern speciation of *Asclepias* is considered to have developed. The greatest floristic affinity is seen between Ozarkia and Appalachia; the least between Ap-

palachia and Orange Island. The least rich in endemics is Appalachia; the richest is Orange Island. This cannot likely be due to hypothetical land bridges between Florida and the Antilles, since at the present time there are but two closely related Antillean species: both annuals, unlike our species, and both very generalized members of a single section of the genus. The high endemism of the Floridian species is interpreted as an effect of the archipelagic nature of the refuge.

The asclepiads apparently have reacted to isolation in differing fashions. It is difficult to distinguish vicarious species, but there seem to be four pairs: one pertaining to Ozarkia and Appalachia, and three to Ozarkia and Orange Island. Two species comprise vicarious subspecies, one divided amongst all three refuges, the other between Ozarkia and Appalachia. Where these vicariads have effected a commissure, they are panmictic and introgression is apparent. Isolation need not necessarily lead to systematic differentiation, and the bicentric or tricentric populations may remain disjunct, or may reknit to form a secondarily continuous distribution.

Species may remain close to their ancestral refuge or may spread indifferently or differentially into newer territory. Some have become extinct or virtually extinct at their putative centers while continuing to expand elsewhere. This varied behavior possibly is the result of differing morphological and biotypic mutation rates.

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Figure 1.

Map 1: Cretaceous shore lines (solid line) and maximum limit of Pleistocene glaciation (chain line) with relation to the refuges of Ozarkia, Appalachia, and Orange Island (compiled from Schuchert & Dunbar, 1933; Schuchert, 1935). Map 2: subspeciation of *Asclepias tuberosa*. Map 3: subspeciation in *A. incarnata*—small dots, *A. i. incarnata;* large dots, *A. i. pulchra*. Maps 3–6: each dot represents a single station per county. Discussion of all maps in the text.

Figure 2.

Maps 7–12: each dot represents a single station per county. Discussion of all maps in the text.

TWO NEW LEGUMINOUS TREES OF BRITISH GUIANA

By N. Y. Sandwith

Among the very large and valuable collections which were made in British Guiana during the war by Mr. D. B. Fanshawe, Assistant Conservator of Forests, material of two Leguminous trees, a *Sweetia* and a *Swartzia*, has enabled me to complete the descriptions of two new species whose identity and affinities have been puzzling me for some years. The *Sweetia* is of great botanical interest, while the *Swartzia*, according to Mr. Fanshawe, is one of the commercial timbers of the Colony. Unless otherwise stated, the specimens cited are all deposited in the Kew Herbarium.

Sweetia **praeclara** *Sandwith*, sp. nov.; ab omnibus speciebus adhuc cognitis staminibus 5 tantum differt, praeterea ob foliola punctata, calycem disciferum bene evolutum, unguem petalorum pilosum necnon formam laminae, ovulum saepissime unicum valde notabilis.

Arbor mediocris vel excelsa, ramulis nigrescentibus glabris cortice laccato tenuiter undulato-striato. *Stipulae* ovatae vel ellipticae, 4.5–9 mm.

longae, 1.75–4.2 mm. latae, coriaceae, longitudinaliter striato-nervosae, sparse pilosulae vel fere glabrae. *Folia* paripinnata vel imparipinnata, 4–6-foliolata, vulgo 10–20 cm. longa, adulta omnino glabra nisi petiolulis nonnunquam sparse pubescentibus, cortice rhacheos ei ramulorum simili omnino convoluto vel supra anguste vel angustissime longitudinaliter fisso-canaliculato, praeterea petiolo basi incrassato petiolulisque crebre transverse undulato-rugosis; petiolus ad 3 cm. longus; internodia rhacheos inaequalia ob dispositionem foliolorum saepe irregularem, 0.75–1.5 mm. diametro; petioluli 2.5–5 mm. longi; foliola opposita vel alterna, elliptico-oblonga vel terminalia nonnunquam elliptico-oblanceolata, apice (vulgo ad 1 cm.) obtuse acuminata, basi cuneata vel rotundata, aliquantulum inaequilatera, ad 13 cm. longa, ad 4.5 cm. lata, coriacea marginibus plus minusve revolutis, utrinque praesertim supra nitidula, infra crebre verruculoso-punctata punctis setis albis minutis deciduis terminatis ceterum glabra, costa supra canaliculato-impressa subtus prominente, nervis primariis utrinsecus circiter 10 angulo lato patulo-ascendentibus rectis sed satis longe a margine anastomosantibus, nervis intermediis parallelis fere aequalibus, venulis reticulationem conspicuam formantibus, omnibus utrinque aequaliter prominulis. *Paniculae* axillares atque terminales, saepe geminatae, ad 10 cm. longae, ubique breviter pilosulo-pubescentes, cortice ei ramulorum simili; ramuli floriferi 1.5–3 cm. longi, basi bracteis stipuliformibus 2–5 mm. longis suffulti; bracteae basi pedicellorum ovatae, acutae, 0.75 mm. longae, 0.5 mm. latae; pedicelli circiter 1 mm. longi; bracteolae supra medium pedicellum minutae, circiter 0.5 mm. longae. *Calyx* campanulato-turbinatus, extra passim intus supra discum glabrum pubescens; pars discifera turbinata 1 mm. longa, pars superior supra discum gamophylla circiter 1.2 mm. longa ad 3.3 mm. latitudinem dilatata; lobi triangulari-ovati, 1.2 mm. longi, 1.2–1.75 mm. lati. *Petala* ut videtur albescentia, libera, margine disci inter stamina inserta, subaequalia, ungue pilosulo 1.2 mm. longo; lamina sagittato-lanceolata, acuta vel obtusa, 2.5–3 mm. longa, 1–1.2 mm. lata, flore aperto reflexa, basi insigniter dilatata cordato-auriculata auriculis inflexis carnosis margine undulatis integris vel crenulatis, prope mediam basin utrinque pubescens ceterum glabra. *Stamina* 5 lobis calycinis opposita, margine disci inserta, filamentis glabris 4 mm. longis e flore aperto conspicue exsertis; antherae late orbiculares, 0.5 mm. longae, 0.75 mm. latae, haud apiculatae. *Ovarium* ovoideum vel ellipsoideum, 2 mm. longum, fere 1.2 mm. latum, dense pilosum, stipite glabro 1.75 mm. longo, stylo 1.3–2 mm. longo basi excepta glabro; ovula saepissime 1, raro 2. *Legumen* oblongum, apice rotundatum minute apiculatum, 5–8.5 cm. longum, 1.4–2.2 cm. latum, applanatum, tenue, scilicet firme chartaceum vel tenuiter coriaceum, glabrum, nitidulum, prominenter reticulato-venosum, sutura superiore ultra nervum limbalem anguste (circiter 1.5 mm.) alato-marginatum; stipes vulgo 3–4 mm. longus. *Semen* 1, elongato-oblongum.

British Guiana. Essequibo River: Makauria Creek, fl. March 1, 1934, *Aitken* in *Forest Dept.* no. 2353 (TYPUS in Herb. Kew.), medium-sized tree about 10 in. diam., on alluvial soil near the creek; *ibid.*, fr.

Sept. 16, 1940, *Fanshawe* in *Forest Dept.* no. 3286, tree 110 ft. high, 14 in. diam., bark creamy, smooth, basally swollen; Moraballi Creek, May 17, 1943, fls. over, *Fanshawe* in *Forest Dept.* no. 4033, tree 90 ft. high, 12 in. diam., in greenheart forest on loam, buttressed to 3 ft., bark with a strong bean scent, calyx creamy green. Bartica-Potaro Road, in sandy wallaba forest near 14th milepost, young buds, August 17, 1937, *Sandwith* no. 1109, tree about 80 ft. high, with whitish buds.

Vernacular name, "Blackheart."

The type (*Forest Dept.* no. 2353) was noted as a tree with the wood chocolate-coloured, the sapwood yellowish white, very narrow and sharply defined. The wood of this species was noted as used for house-posts, furniture, etc.

The seeds of the ripe pods of *Forest Dept.* no. 3286 are almost all bored and damaged by insects, so that it has not been possible to give a satisfactory description of them. They appear to be about 6–7 mm. long (perhaps longer), 2–3 mm. broad and up to 2.5 mm. thick.

Seedling specimens were collected by Mr. Fanshawe, *Forest Dept.* no. 3631, on Oct. 16, 1942, in "Turu" palm swamp on white sand near the Keriti Creek, Essequibo River. He notes that they come from the early 1941 crop of seed, but that their age is indeterminate. The leaves are trifoliolate, while the canaliculate petiole and rhachis are very narrowly wing-margined, the wings being produced into stipel-like lanceolate-subulate points at the nodes below the petiolules. The leaflets are small, either opposite or alternate, up to 3.7 cm. by 1.7 cm., and more elliptic in outline than those of the mature tree; otherwise, they are very similar in appearance and venation, and in their acuminate apex. Like the old leaflets, they are punctate on the lower surface, the dots being dark, not pellucid, and terminated by minute white stiff bristles which are more or less adpressed to the surface. These bristles, which can be seen only under a lens, are sometimes evident on the older leaflets, but have very often disappeared.

This remarkable tree, as can be seen from the diagnosis, presents a number of outstanding characteristics which might appear to warrant the creation of a new genus. On the other hand, in general facies, foliage, inflorescence and especially fruit, it fits so well into *Sweetia*, and into no other genus, that I have no hesitation in placing it there as a new species with anomalous characters. On account of its relatively membranous, reticulate-veined pods it resembles such species as *S. panamensis* Bth., *S. dasycarpa* (Vog.) Bth. and *S. elegans* (Vog.) Bth., rather than the other

Guiana and Amazon representative of the genus, *S. nitens* (Vog.) Bth., which has short coriaceous pods and long stout inflorescence-branches. Indeed, the facies of the leaflets and inflorescence, added to the character of the pods, suggests a closer affinity with *S. panamensis* and *S. dasycarpa*, the former of which occurs in Central America from southern Mexico to Panama, while the latter is plentiful and variable in central Brazil but is not found in Amazonia. I have found distinctly dotted leaflets in no other species of *Sweetia:* pellucid dots are characteristic of the leaflets of the allied genus *Myrocarpus*, which has a very different pod. The reduction of stamens and ovules would not by itself justify the creation of a new genus, while the peculiar shape of the blades of the petals might well be due to the absence of the additional stamens which has allowed some freedom for greater development.

Swartzia **Bannia** *Sandwith*, sp. nov.; apetala, in serie *Tounateae* ponenda, foliolis *S. leiocalycinam* Bth. statim revocans sed indumento paginae inferioris e pilis longioribus minus coarctatis constituto, illo inflorescentiae haud cinnamomeo-ferrugineo, praeterea absentia petali, ovario tomentoso stipite styloque multo breviore longe abhorret; inflorescentia *S. Benthamianam* Miq. atque *S. laevicarpam* Amshoff revocans, a quibus indumento foliolorum, absentia petali sed praecipue forma fructus differt; a *S. apetala* Raddi indumento foliolorum pauciorum, racemi, calycis, ovarii brevistipitati distinguitur; ab apetala *S. guianensi* (Aubl.) Urb. rhachi foliorum exalata, foliolis coriaceis subtus pallidis sericeo-pubescentibus, floribus multo minoribus sepalis intus glabris facile distinguenda.

Arbor satis parva, trunco (teste Fanshawe) hic illic per brevia spatia profunde sulcato-striato atque fenestrato; ramuli graciles, teretes, glabrati, 3 mm. diametro, ultimi tenues pilis flavescentibus vel saepius ferrugineis pubescentes. *Stipulae* subulatae, 2–4 mm. longae. *Folia* haud magna, 3–5-foliolata (plerumque 3-foliolata), petiolo rhachique nudo gracili subterete pubescente; petiolus 0.7–2.3 cm. longus; internodium rhacheos inferius 3.5 cm. longum, superius terminale 0.8–2 cm. longum; petioluli dense pubescentes, 2.5–3 mm. longi; foliola anguste elliptica, elliptico-oblonga vel anguste elliptico-lanceolata, apice conspicue (0.5–1.5 cm.) anguste acuminata, basi cuneata, 4.5–12.5 cm. longa, 1.4–4.3 cm. lata, coriacea marginibus revolutis, supra nitidula glabra costa canaliculato-impressa nervis lateralibus impressis cum reticulatione areolarum intricatissima sub lente tantum obviis, subtus pallida pilis arcte adpressis subsericeo-pubescentia costa valde prominente nervis lateralibus patulo-ascendentibus obscuris saepe vix distinguendis. *Racemi* axillares, graciles, cum fructibus saepe arcuati, 6–9 cm. longi, pilis flavescentibus nitidulis dense adpresse pubescentes; bracteae ad 1.2 mm. longae; bracteolae desunt; pedicelli 3–4 mm. longi. *Alabastra* ovoideo-subglobosa, breviter

obtuse apiculata, 3–4 mm. diametro, pilis flavescentibus nitidulis sericeo-pubescentia. *Calyx* irregulariter rumpens, demum in lobos 4 reflexos 3–4 mm. latos intus glabros fissus. *Petalum* deest. *Stamina* majora 2, filamentis glabris 4 mm. longis, antheris 1.2–1.3 mm. longis 1 mm. latis; minora numerosissima inaequalia, filamentis glabris, antheris ad 0.75 mm. longis ad 0.8 mm. latis. *Gynoecium* stipite tomentoso 2.5–3 mm. longo; ovarium oblongum, 3.5 mm. longum, 1.75–2 mm. latum, tomentosum; stylus excentricus, brevissimus, ad 0.3 mm. longus, conicus, uncinato-inflexus, apice glaber obtusus. *Legumen* aurantiacum, oblongo-ellipsoideum, turgidum, bivalve, 2–2.5 cm. longum, vulgo 1.5 cm. diametro, adpresse pubescens, demum glabratum, stipite 5 mm. longo; semen unicum nigrum, nitidum, ovoideo-ellipsoideum, circiter 1.3 cm. longum, 1 cm. diametro, arillo albo 1 cm. longo insidens.

British Guiana. Demerara River: in Dakkama (*Dimorphandra conjugata*) scrub on white sand, Ituni Road, Mackenzie, fr. June 5, 1945, *Fanshawe* in *Forest Dept.* no. 5241 (typus in Herb. Kew.); tree 40 ft. high, 12 in. diam., deeply fluted over short lengths of bole forming windows or troughs in the wood, leaves brittle, fruit orange, seed glossy black, half covered by white aril. Berbice River: Eberobo River, fr. May 31, 1919, *Hohenkerk* in *Forest Dept.* no. 793; "hardwood used for house posts and spars." Mazaruni, *Appun* 19.

Surinam. Zanderij I Reserve, fl. July, 1946, *B. W.* (Wood Herbarium) no. 173 (duplicate from Utrecht Herb.).

Vernacular name, *Bannia* (*Arawak*), according to Fanshawe and Appun. "Ebony" follows "Bannia" on Appun's labels; while Hohenkerk noted his tree as "Shibalidanni" (*Arawak*).

According to Mr. Fanshawe, this is one of the commercial timbers of British Guiana.

In my account of the British Guiana species of *Swartzia* (Kew Bull. 1934, 353–368) I incorrectly referred the Appun collection, which consists only of branchlets and leaves, to *S. leiocalycina* Bth.; while I placed *Forest Dept.* no. 793 in a list of collections which I could not determine without more complete material. The excellent fruiting specimens collected by Mr. Fanshawe, together with flowering racemes and leaves which were kindly presented to me by Dr. J. Amshoff, of the Utrecht Herbarium, have at last enabled me to draw up a description of this interesting new species, the nearest relative of which is perhaps *S. apetala* Raddi, which occurs in Surinam (as var. *acuminata* Amshoff). The fruit of *S. leiocalycina* is still unknown.

Royal Botanic Gardens, Kew.

THE TECHNICAL NAME OF ALLSPICE

By E. D. Merrill

Allspice was originally characterized, under the binomial system, as *Myrtus Pimenta* Linn. Sp. Pl. 472. 1753. Its basis was a series of references to pre-Linnaean literature, for Linnaeus in 1753 had no specimen representing it in his herbarium. Even if all the cited references may not apply to a single species there is no difficulty in determining just what Linnaeus had in mind, which was the West Indian allspice tree. The generic synonymy is Pimenta Lindl. Collect. Bot. sub *pl. 19.* 1821[1] (*Pimenta* O. Berg, Handb. Pharm. Bot. ed. 3, 1: 338. 1855[2]; *Myrcia* Soland. ex Lindl. Collect. Bot. sub *pl. 19.* 1821, non DC., 1826; *Evanesca* Raf. Sylva Tellur. 105. 1838; *Pimentus* Raf. l. c.). It will be noted that in date of publication *Myrcia* Soland. ex Lindl., 1821, antedates the publication of the very large genus *Myrcia* DC., 1826, by five years, and actually invalidated the latter name. Manifestly in this case *Myrcia* DC., 1826, should be officially conserved against *Myrcia* Soland. ex Lindl., 1821.

Lindley, Collect. Bot. sub *pl. 19.* 1821, realized that the Linnaean species could not be retained in *Myrtus*, and for it he casually published the new generic name *Pimenta* Lindl., with the binomial *P. officinalis* Lindl. The name-bringing synonym *Myrtus Pimenta* Linn. is indicated only by inference. Lindley's binomial has, in general, been accepted for more than a century, but in that time a rather formidable synonymy has been built up.

[1] The title page date of Lindley's Collectanea botanica is 1821 and all of the eight fascicle covers bound at the end of the volume in the Arnold Arboretum set are so dated. The date in current literature is indicated as 1821–24. In a sheet dated Oct. 21, 1821, that may have been distributed with fascicle four, the statement is made that the author had resolved "upon abandoning the undertaking altogether after the publication of four more numbers. These will appear at uncertain intervals." Clearly, plates 1 to 20, with accompanying text, were published in 1821, as the original plan involved five plates with accompanying text in each fascicle, to be issued in monthly parts. More may have been issued in 1821, perhaps fascicles five and six, plates 21 to 30. In the text to plate 30, *Spiranthes pudica* Lindl., the statement is made that the drawing was based upon a specimen imported "in the spring of the present year (1821); and flowered . . . in July last." Under plate 38, *Vanda multiflora* Lindl., the statement is made that the illustration was prepared in July, 1822; under plate 39A, *Ionopsis utricularioides* (Sw.) Lindl., that the plate was made in May, 1824; and under plate 39B, *Sarcanthus rostratus* Lindl., that it was prepared in July, 1822. The last fascicle presumably containing plates 36 to 41B could not have been issued before 1824.

[2] T. Nees von Esenbeck and K. H. Ebermaier, Handb. Med.-Pharm. Bot. ed. 3, 3: 270. 1832, developed the same idea independently, for occasionally one notes that Nees is cited as the author of the genus *Pimenta*. They say, sub *Eugenia Pimenta* DC. (*Myrtus Pimenta* Linn.): "Man könnte demnach aus Pimenta eine eigene Gattung bilden, die sich in dem Bau des Embryo der Gattung Myrtus nähert."

One suspects that this was due, in part, to the obscureness in Lindley's original publication of the new generic name; for 34 years later, O. Berg selected the same generic name, and formally characterized the genus as *Pimenta* O. Berg, Handb. Pharm. Bot. ed. 3, 1: 388. 1855, his binomial published on page 389 being *Pimenta officinalis* Berg. Lindley's original publication is:

"The Allspice plant of the West Indies was long ago considered a distinct genus by Dr. Solander, who has called it *Myrcia* in his manuscripts. It has a straight style, a stigma somewhat capitate, an ovary with two cells, each containing a single ovulum hanging from its middle from the top of the dissepiment, its seeds solitary, with the organization of *Myrtus*. *Myrcia* being very near *Myrsine* in sound, we would propose that the specific be altered to a generic appellation, and that the plant be called PIMENTA *officinalis*."

It now becomes evident that under the provisions of the International Code of Botanical Nomenclature the Lindley binomial is no longer tenable, and unfortunately we must accept the not very appropriate specific name *dioica* for a plant which has perfect flowers. In 1838 Rafinesque proposed the genus *Evanesca* Raf. based on *Myrtus dioica* Linn. Syst. ed. 10, 1056. 1759, and it is the distinctly misleading Linnaean specific name that has priority. The original Linnaean description is short and unsatisfactory, consisting merely of: "dioica B. M. pedunc. trichotomo paniculatis, fol. oblongis, flor dioicis. *Miller*." Four years later, Sp. Pl. ed. 2, 675. 1763, he somewhat amplified this description in: "Myrtus pedunculis trichotomo-paniculatis, foliis oblongis floribus dioicis. *Habitat in* America. Miller ♄ Folia *opposita, lanceolato-ovata, crassa. Pedunculi axillares & terminales, brachiato-paniculati, longitudine foliorum.* Petala *pauca*." This was all that was known regarding *Myrtus dioica* Linn. until the problem of trying to identify the status of *Evanesca* Raf. arose. One suspects that Rafinesque's attention was arrested by the specific name *dioica* and that he correctly realized that no dioecious plant could properly belong in *Myrtus* Linn.; that genus is characterized by having perfect flowers, which, incidentally, is a character of the whole family, except that in some genera polygamous flowers occur. Rafinesque's genus had been disposed of as a synonym of *Myrtus* Linn. It now proves to be a synonym of *Pimenta* Lindl.

An examination of an enlarged print from the microfilm record of the specimens in the Linnaean herbarium at the Arnold Arbo-

retum indicated that unquestionably a myrtaceous species was represented by the holotype of *Myrtus dioica* Linn. The print was not sufficiently clear to show certain details, and from it there was naturally no explanation of the selection of the specific name. The entry in Savage's Catalogue of the Linnaean Herbarium 87. 1945, is definite, being: "dioica B [*upper spec:*] mas. [*lower spec:*] femina. [Sm:] *right.* // Myrtus arborea aromatica, foliis laurinis a Millero. Mas et femin[a] in diversa arbore." It is clearly from this last statement that Linnaeus derived the idea that the species was a dioecious one. As far as one can determine from a photograph, manifestly but a single species was represented by the two specimens.

Not satisfied that the statement on the sheet was entirely correct as to the plant being dioecious I asked Mr. I. H. Burkill to examine the Linnaean specimen to see what the explanation might be. On November 15, 1946, after examining the specimen critically, he wrote, *inter alia:* "I cannot understand why *mas* and *fem.* were written on the sheet when the specimen marked *femina* has actually a few anthers in addition to the stubs of numerous filaments." He suggests that most of the anthers on this specimen may have been destroyed by insect depredations.

With these data in hand, which explained the misleading specific name assigned to the species by Linnaeus, together with certain suggestions made by Mr. Burkill as to the identity of the Linnaean type of *Myrtus dioica* Linn., the matter of its determination was considered. I was convinced, as were my immediate associates, that *Myrtus dioica* Linn. is identical with *Pimenta officinalis* Lindl., and this was confirmed by Mr. Burkill in January, 1947, after re-examining the Linnaean type. This enabled me to place the genus *Evanesca* Raf. but it also involves an undesirable change in the specific name of a well-known economic plant. Perhaps the time has come to suggest that an amendment be made to the code of botanical nomenclature (assuming that botanists may still be unwilling to set up a list of conserved binomials), whereby, at least for well-known economic species, currently used names that have stood the test of time for a century shall not be changed in case an earlier specific name be located.

Mr. Burkill, after re-examining the Linnaean type, wrote under date of January 24, 1947: "You were right; *Myrtus dioica* is *Pimenta officinalis.* I decided that yesterday by comparing a number of Kew specimens with the type of *Myrtus dioica* Linn. The bulk of the Kew material has leaves tending to have their

maximum breadth at mid-length and often rounded at the apex and this is combined with a slight greyishness underneath; but among them are others, apparently specimens derived from cultivated trees in the orient and in the Mascarene Islands, with obtuse but scarcely rounded leaves tending to elliptic in outline and without the greyishness. It is these that the Miller specimen in the Linnaean herbarium matches.

"Assuming Jamaica as the country of origin and Williams the probable sender of the specimens to Miller, we find Linnaeus the recipient of the two twigs from Miller, one called *mas* and the other *foem.*, with a letter dated 22 April, 1754, asserting that he had received from America specimens proving that the flowers of *Pimenta* are dioecious, and that therefore Linnaeus had misplaced the species in his Species Plantarum (*Myrtus Pimenta* Linn.)."

It may be noted that in Martyn's edition of Miller's Dictionary (1807), the first form that Mr. Burkill mentions is characterized as long-leaved pimento, *Myrtus Pimenta* Linn. var. α, and the second as short-leaved pimento, *Myrtus Pimenta* Linn. var. β.

Miller's first statement regarding there being male and female flowers appears in his Dictionary, ed. 7, 1759, under *Caryophyllus foliis lanceolatis*, etc. In edition 8, 1768, when he accepted the binomial system, he amplified the statement, from which the following is quoted:

"The flowers . . . are male and female upon distinct trees. I was favoured with fine samples of both, and also a particular account of the trees, by William Williams, Esq.; of St. Anne's, on the north side of Jamaica, who has the greatest number of these trees on his plantation of any person in that island. The male flowers have very small petals, and a great number of stamina in each, which are of the same colour with the petals, terminated by oval bifid summits; the female flowers have no stamina, but an oval germen, situated below the flower, supporting a slender style, with a blunt stigma at the top. . . . The usual season when these trees flower, is June, July, and August."

This statement as to the male and female flowers being on separate trees is modified in Martyn's edition of Miller's Dictionary. The modifying statement is:

"Mr. Miller says they are male and female upon distinct trees, and describes both. Swartz informs us that the Pimento is a polygamous tree; having the barren and fertile flowers either together, or on a distinct tree . . .

"Browne says, that some of these trees are frequently observed to be barren, which has introduced a notion among the people of

Jamaica of there being male and female trees in general, and that some of the male or barren trees were requisite in every walk; all those that he observed bore only hermaphrodite flowers, and he was credibly informed that those called male trees, when lopped or broken like the rest for one or two years, bear very well; which he is the more apt to believe, as he never observed a distinct male or female flower on any of them."

In following up this problem an appeal was made to the Director of Agriculture, Kingston, Jamaica. On February 20, 1947, the senior botanist Mr. L. N. H. Larter courteously responded. From his letter the following pertinent data are quoted:

"Evidence upon the subject is conflicting. I have, from time to time, examined trees on pimento properties which have been pointed out to me by owners as 'male' trees and in every case I have found that the flowers are structurally hermaphrodite, and often such trees will bear fruit but in much less quantity than the so-called female trees. I have attributed this to results of the method of harvesting pimento. The common practice is to tear off the twigs bearing the fruit and in some cases to cut off relatively large branches with a machete. This rather drastic method of harvesting may be expected to weaken the tree, with the result that a badly damaged tree might fail to set fruit in the following season. It is a well known fact that pimento tends to be biennial in cropping and this may be attributed in part to the rough treatment the trees get and in part to variation in climatic conditions from year to year. This hypothesis is to some extent supported by the remark of one pimento grower who informed me that since he has taken to clipping off the fruit with secateurs, he has noticed that there are fewer 'male' trees on the property. In spite of enquiries I have not yet found a planter who can produce unequivocal evidence that the same tree remains 'male' from year to year. It is quite possible that any trees which fail to bear in any one year are regarded as 'male'.

"The pimento plant shows a considerable amount of variation and it is possible that genetic considerations may be involved; some strains may be considerably more sterile than others. I personally have come across no evidence of either polygamy or dioecism in this species.

"The following information taken from an article in the 'Agricultural News' published by the Imperial Department of Agriculture for the West Indies, volume 4, No. 90, page 295, (1905) may be of interest:

"'There are two kinds of pimento trees, viz., the fruitful or bearing tree, and the unfruitful, or, as it is commonly termed, the male tree. They are very much alike in appearance, and can only be distinguished by experienced eyes. It is held by botanists that the so-called 'male' trees are not necessary to the fructifying of the bloom on the bearing trees, and that they are simply barren trees of no use to the grower and, excepting when they are useful as shade trees, are better out of the way. Many growers, however, find it difficult to reconcile this theory with actual experience, holding that when all the 'male' trees are cut out, the yield of the other trees is not equal to what it had been before the axe was put to work.'

"The following is an extract from a report from the files of this Department by Mr. Robert Thomson, Superintendent Botanic Gardens, to the Colonial Secretary of Jamaica, dated 28th September, 1872:—

"'Pimento.—This well known product of Jamaica abounds in several Parishes, but chiefly in St. Anns. There are two perfectly distinct varieties of the plant, one of which is popularly called the 'Male tree', and is constantly found in companionship with the other, or bearing tree. Notwithstanding the assertion of the Botanists, giving advice on the subject, that as the bearing tree possesses both male and female organs, and is consequently capable of self fertilization, the male tree is futile, and should therefore be destroyed. Large owners of Pimento have maintained from experience, that the male tree is indispensable to fertilization, or at all events to a good crop. If the futility of the male tree could be once satisfactorily established, it would be a matter of importance, as it would inspire confidence in the growers to destroy these, which at present occupy about a fifth part of most Plantations. Both kinds of trees possess hermaphrodite flowers, and the male on some occasions produce sufficient opportunity of testing, and which I think further investigation will tend to confirm, namely, that the male plant possess much stronger male organs, and vice versa, the bearing plant much stronger female ones. Should my observation prove correct the utility of the male tree in the plantation can easily be understood.'

"Observations embodied in the latter extract agree with my own. The conclusions however are open to question, as the observations are not incompatible with suggestion that this particular variation may be due to either incompatibility or sterility factors."

637.11

B. dioica right

FIGURE 1. A sketch of the actual holotype of *Myrtus dioica* Linn., sheet 637.11 in the Linnaean herbarium, based on a photograph of the specimen. The left-hand specimen, in full flower, marked *mas.*, the right-hand specimen showing very few stamens (these mostly destroyed), marked *femina.*

The synonymy of allspice is as follows:

PIMENTA **dioica** (Linn.), comb. nov. FIGURE 1.

Myrtus dioica Linn. Syst. ed. 10, 1056. 1759; Sp. Pl. ed. 2, 675. 1763.
Myrtus Pimenta Linn. Sp. Pl. 472. 1753.
Caryophyllus Pimento Mill. Gard. Dict. ed. 8, [178]. 1768.
Myrtus Pimenta Linn. var. *longifolia* Sims, Bot. Mag. **30:** *pl. 1236.* 1809, cum syn.
Myrcia Pimento* Soland. ex Sims, l. c., in syn., *descr.*
Pimenta officinalis Lindl. Collect. Bot. sub *pl. 19.* 1821; Fawcett & Rendle, Fl. Jamaic. **3:** 325. *fig. 126.* 1926, cum syn., based on *Myrtus Pimenta* Linn.
Eugenia Pimenta DC. Prodr. **3:** 285. 1828, based on *Myrtus Pimenta* Linn.
Myrtus Tabasco Schlecht. & Cham. in Linnaea **5:** 559. 1830.
Pimenta aromatica Kostel. Allgem. Med. Pharm. Fl. **4:** 1525. 1835, based on *Myrtus Pimenta* Linn.
Pimenta vulgaris Lindl. in Loud. Encycl. Pl. 418. 1829; Wight, Ill. Ind. Bot. **2:** 13. *pl. 97, fig. 7.* 1841, based on *Myrtus Pimenta* Linn.
Evanesca crassifolia Raf. Sylva Tellur. 105, 1838, based on *Myrtus dioica* Linn.
Pimentus vera Raf. l. c., based on *Myrtus Pimenta* Linn.
Eugenia micrantha Bertol. Fl. Guatimal. 22. 1840, non DC.
Pimenta officinalis O. Berg, Pharm. Bot. ed. 3, **1:** 339. 1855, based on *Myrtus Pimenta* Linn.
Pimenta communis Benth. & Hook. f. Gen. Pl. **1:** 717. 1865, based on *Myrtus Pimenta* Linn.
Pimenta Pimenta Karst. Deutsche Fl. Pharm. Med. Bot. 790. 1882; Cockerell in Bull. Torr. Bot. Club **19:** 95. 1892, based on *Myrtus Pimenta* Linn.
Myrtus piperita Sessé & Moc. Fl. Mex. 136. 1894.

The species is a variable one, especially in the shape and size of its leaves and in the size of its fruits. Many varieties have been proposed, some as α and β, others under trinomials. Berg, Linnaea **27:** 422–424. 1854, described and defined the varieties *cumanensis*, *longifolia*, *ovalifolia*, *tenuifolia*, and *tabasco*, but later authors have not followed him; earlier than Berg's proposals were the varieties *brevifolia* Hayne, *longifolia* Sims, and *ovalifolia* DC. No attempt is made here to evaluate the minor categories in what I take to be a reasonably well defined but at the same time a somewhat variable species.

Allspice is native to parts of Mexico, Central America, the West Indies, and possibly parts of northern South America. On

* Not listed in Index Kewensis.

some of the herbarium specimens that I have examined from parts of Central America, the notes indicate that the species was not native. Specimens examined came from various parts of Mexico (Oaxaca, Vera Cruz, Tabasco, Yucatan), British Honduras, Honduras, Guatemala, Salvador, Costa Rica, Bermuda, Cuba, Jamaica, Trinidad, Mauritius, and Ceylon. Standley states, Contr. U. S. Nat. Herb. **23:** 1037. 1924: "Veracruz, Oaxaca, Tabasco, and probably elsewhere [in Mexico]. Central America, West Indies, and northern South America."

One suspects that because of the demand for its product, allspice, that the species may have been more or less distributed here and there in tropical America by pre-Columbian man; certainly following European colonization man has been an important agent in its distribution not only in tropical America, but in the Old World tropics as well. Jamaica is still an important source of allspice, the tree still being extensively cultivated there.

It may be that *Caryophyllus Pimento* Mill., 1768, was based on a duplicate of the same collection as *Myrtus dioica* Linn., 1759, as Miller actually sent specimens to Linnaeus in 1754; but no specimen of Miller's species has been located in the Sloane herbarium at the British Museum of Natural History.

Arnold Arboretum, Harvard University.

[1] While this paper was in galley proof I received a courteous letter from Mr. Egbert A. Tai, Agricultural Officer, Department of Agriculture, Jamaica, who sent a specimen of the "male" tree in flower, the following paragraph being quoted from his letter:

"The tree from which it was taken is growing at Orange Valley, St. Ann, near the north coast of the island and is estimated to be about twenty five years old. It has never produced fruit although it has flowered each year. A remarkable thing is that it flowers after fruit has set on the bearing trees and it could serve no useful purpose as a pollinator. The same holds for a number of other 'male' pimento trees seen in the locality."

An examination of a number of flowers on this specimen shows that they are perfect, the ovules well developed, the anthers present in great numbers, and the pollen normal. This may be a genetic strain where most of the flowers are self sterile.

PLEOMELE FERNALDII (LILIACEAE), A NEW SPECIES FROM THE HAWAIIAN ISLANDS. HAWAIIAN PLANT STUDIES 16[1]

By Harold St. John

Pleomele **Fernaldii** St. John, sp. nov. (Pl. 3).

Diagnosis typi.—Arbor recta glabra 8 m. alta 2 dm. diametro, ramis paucis dichotomis griseis a internodiis brevibus elevatis asperatis, ramulis 8–12 mm. diametro pallide luteo-brunneis a foliorum cicatricibus linearibus pallide luteis semicinctis et a margine superiore internodorum brunneorum 0.3–3.5 mm. altis asperatis; foliis terminalibus in plumam aggregatis, laminis sessilibus 12–21 cm. longis 9–14 mm. latis laevibus subcoriaceis liguliformibus marginibus tenuibus pallide cartilagineis angusto intervallo supra basim amplectantem paullo contractis parte tertia ultima ad apicem subacutum callosum longe cucullati-tubulosum sensim minuente, nervis parallelis numerosis, nervo medio nullo, paniculis solitariis terminalibus valde recurvatis pendentibus; pedunculo 8–14 cm. longo 7–10 mm. diametro perspicue foliaceo-bracteoso, paniculis 25–32 cm. longis 12–20 cm. diametro ramis lateralibus simplicibus per angulum angustum divergentibus a bractea foliosa vel pallide lutescentea 2–6 cm. longa subtenta, nodis fertilibus a bractea 1 (vel 2) 4–8 mm. longa alba ad apicem rubescente ad basim subtendentibus, pedicellis 4–12 mm. longis filiformibus pendentibus ad apicem articulatis; alabastris tomaculiformibus subfalcatis lobis perianthii imbricatis, basi perianthii pedicelliformi contracto 1–1.5 mm. longo, tubo perianthii 15–18 mm. longo subcylindrico paullo ad basim deminuente ad medium 5–7 mm. diametro, lobis perianthii 9–11 mm. longis uninervosis anguste oblongis ad apicem cucullatum paullo deminuentibus, 3 lobis exterioribus paullo longioribus angustioribusque; filamentis in fauce affixis 10–11 mm. longis subulatis compressis exsertis, antheris 3.5–4 mm. longis lineari-oblongis pallide luteis; ovario obovoideo viridi, stylo 23 mm. longo filiformi, stigmatibus truncatis minutissime trilobatis; baccis colore cerasis similibus 1–2–3-lobatis depresso-globosis 5–10 vel 10–17 mm. diametro, mesocarpio carnoso tenui, endocarpio tenui pallido cartilagineo; seminibus 4–8 mm. diametro laevibus pallide brunneis orbicularibus vel semiorbicularibus vel tertio-orbicularibus; descriptione fructuum ab exemplo numero 22,602 obtenta.

Description from All Material Examined.—Tree, glabrous, 6–8 m. tall, 1.5–2 dm. in diameter, erect, the branches few, dichotomous, gray, roughened by the short, raised internodes; youngest branchlets just below the foliage 8–12 mm. in diameter, pale yellowish brown, half ringed by the pale, transversely linear leaf-scars and roughened by the salient upper

[1] This is the sixteenth of a series of papers designed to present descriptions, revisions, and records of Hawaiian plants. The preceding papers have been published in Occ. Pap. Bishop Mus. x (4), 1933; x (12), 1934; xi (14), 1935; xii (8), 1936; xiv (8), 1938; xv (1), 1939; xv (2), 1939; xv (22), 1940; xv (28), 1940; xvii (12), 1943; Proc. Calif. Acad. Sci. IV, xxv (16), 1946; Bull. Torrey Bot. Club lxxii: 22–30, 1945; Lloydia vii: 265–274, 1944; Pacif. Sci. i: 5–20, 1947; and no. 15 is in press.

ridge of the brownish internode which is 0.3–3.5 mm. high; leaves crowded in a terminal plume, 12–38 cm. long, 9–25 mm. wide, commonly 20 cm. long by 12 mm. wide, sessile, smooth, subcoriaceous, strap-shaped, slightly narrowed above the amplectant base which is 1.5–2 cm. wide, the upper third gradually narrowed to the callous, long cucullate-tubular, subacute tips, veins parallel, numerous, striate, but no midrib evident, margin thin, pale, cartilaginous; panicles single, terminal, sharply recurved and pendent; peduncle 8–16 cm. long, 7–10 mm. in diameter at base, stout, with a few foliaceous bracts; panicle 20–35 cm. long 10–20 cm. in diameter, each lateral branch subtended by a foliaceous or pale yellowish bract 2–6 cm. long, lateral branches simple, diverging at an acute angle; each fertile node subtended by 1–2 bracts 4–8 mm. long, chartaceous, white towards the tip, reddish at base; pedicels 3–12 mm. long, slender, pendent, jointed at apex; flower-buds sausage-shaped and subfalcate, the lobes imbricate; flowers yellowish-green or greenish yellow; perianth-tube abruptly contracted to a pedicel-like base 1–1.5 mm. long, the expanded tube 14–18 mm. long, subcylindric but slightly narrowed from the throat to the base, at the middle 5–7 mm. in diameter; perianth-lobes 8–11 mm. long, 1-nerved, the outer three slightly longer and narrower than the inner three, all narrowly oblong, somewhat narrowed to the cucullate tip; filaments attached in the throat, 9–11 mm. long, flattened, subulate, descending and exserted; anthers 3.5–4 mm. long, linear-oblong, pale yellow; ovary obovoid, green; style 20–23 mm. long, filiform, the tip truncate, only slightly enlarged and with 3 scarcely perceptible lobes; berries cherry red, either with 1 fertile cell and then 5–10 mm. in diameter or with 2 or 3 fertile cells and then 10–17 mm. in diameter, depressed globose, 2- or 3-lobed, with a thin, juicy mesocarp, but drying and shrinking; endocarp thin, pale, cartilaginous; seeds 4–8 mm. in diameter, shaped as a full, half, or third of a sphere, smooth, pale brown.

TYPE: HAWAIIAN ISLANDS, LANAI: South ridge of Holopoe Gulch, Mahana, lower edge of forest, 2,000 ft. alt., tree 8 m. × 2 dm., flowers yellowish green, April 6, 1947, *H. St. John & R. S. Cowan* 22,666 (fl.), (Bishop Mus; isotype in Gray Herb.).

SPECIMENS EXAMINED.—LANAI ISLAND: Kaa, April 4, 1914, *G. C. Munro* 38 (fl.); Kaena, April 4, 1914, *G. C. Munro* 324 (fl.); Kanepuu, Kaa, 1,700 ft. alt., low dry windswept forest of *Osmanthus sandwicensis*, April 5, 1947, *H. St. John & R. S. Cowan* 22,631 (fl.); Kapano Gulch, Kalulu, moist wooded gulch, 2,200 ft. alt., April 6, 1947, *H. St. John & R. S. Cowan* 22,651 (fl.); S. W. ridge of Kaiholena Gulch, Kamoku, 2,200 ft. alt., common in lower forest, April 4, 1947, *H. St. John & R. S. Cowan* 22,595 (fl.); ditto, *H. St. John & R. S. Cowan* 22,602 (fr.).

The first Hawaiian member of this group was *Dracaena aurea* Mann, published in Proc. Am. Acad. Arts Sci. vii: 207, 1867. It was listed as "Not uncommon throughout the islands." No specimens were cited, but in the addenda, one was mentioned: M. & B. 36. This stands for Mann & Brigham, but the number

PLEOMELE FERNALDII St. John

printed was erroneous, for the specimens, both at the Gray Herbarium and the Cornell Herbarium, are of no. 362. This original species was accepted by Degener as *Pleomele aurea* (Mann) N. E. Br., and a new species, *Pleomele Forbesii* with smaller flowers and narrower leaves from the Waianae Mountains of Oahu, was described in his Fl. Haw. fam. 68: Aug. 10, 1932.

The segregate genus *Pleomele* has not been generally adopted. Some years ago the writer investigated this group. The species of the true genus *Dracaena* have the perianth without evident tube, divided nearly to the base, and the filaments dilated and thickened at the middle. The species of *Pleomele* have the perianth united ⅓ or more of its length into an evident tube, and the filaments filiform or flattened subulate, tapering to the tip. All the species represented in the Bishop Museum fall readily into one or the other of these two groups, as presented by N. E. Brown, and the two appear to represent good genera. The known Hawaiian species agree with the characteristics of *Pleomele* of Salisbury.

There is abundant material of *Pleomele aurea* (Mann) N. E. Br. It is common on both mountain ranges of Oahu. It is distinguished by having a height of 8–12 m., a diameter of 3–10 dm.; branchlets 15–30 mm. in diameter; leaves 38–58 cm. long, long-tapering to the tip from below the middle; panicles 25–40 cm. long; pedicels 8–16 mm. long; pedicel-like base of perianth 4–7 mm. long; perianth tube 32–38 mm. long; perianth lobes 13–16 mm. long; filaments 12–13 mm. long, flattened subulate, the proximal side channeled above and from the middle down with the thin margins infolded; anthers 4.2–5 mm. long; berries 12–20 mm. in diameter. *P. aurea* is well illustrated by J. F. Rock, in Indig. Trees Haw. Ids. pl. 34–36, 1913, and by O. Degener in Fl. Haw. fam. 68: Aug. 10, 1932. The new *P. Fernaldii* can be separated by its having a height of 6–8 m., a diameter of 1.5–2 dm.; branchlets 8–12 mm. in diameter; leaves 12–38 cm. long, the upper third gradually narrowed; panicle 20–35 cm. long; pedicels 3–12 mm. long; pedicel-like base of perianth 1–1.5 mm. long; perianth tube 14–18 mm. long; perianth lobes 8–11 mm. long; filaments 9–11 mm. long, flattened subulate; anthers 3.5–4 mm. long; berries 5–17 mm. in diameter. With these numerous structural differences, there is no doubt but that this tree from Lanai Island is a distinct species. It was once mentioned by Degener and given the nomen nudum *Pleomele lanaiensis* in his Fl. Haw. fam. 68: Aug. 10, 1932. Recent collections on Lanai

by the writer furnished abundant material. All specimens cited are in the Bishop Museum. The accompanying drawing was made from fresh material by Florence Mekeel.

This new species is named in warm tribute to Professor Merritt Lyndon Fernald, my principal teacher of botany. His devotion to science, tireless research, originality, arduous but joyous field exploration, broad scholarship, and vivid inspiring teaching are known to all systematic botanists. At least one other Hawaiian plant already bears his name, for J. F. Rock described a handsome shrub in the Lobeliaceae as *Cyanea Fernaldii*, in Mem. Bishop Mus. vii (2): 235–237, Pl. 128, 1919.

Explanation of Plate

Plate 3. Pleomele Fernaldii St. John, habit and flowers from type, Mahana, Lanai, *St. John & Cowan* 22,666. Fig. a, habit × ¼; Fig. b, flower, × 1; Fig. c, flower, × 1; Figs. d, e, berry, × 1, from Kamoku, Lanai, *St. John & Cowan* 22,602; Figs. f, g, seeds of same, × 1.

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THE ORIGIN OF THE COMPLEX OF BROMUS CARINATUS AND ITS PHYTOGEOGRAPHIC IMPLICATIONS

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Both cytogenetic experiments in the laboratory and studies of wild species in nature have now established firmly the fact that in the higher plants sterile hybrids between distantly related species have very frequently been converted into fertile, constant, self-reproducing species by the process of doubling the chromosome number, or polyploidy. These hybrid polyploids, or allopolyploids, are often more vigorous than either of their parental species, and may therefore acquire geographical distributions which range far beyond those of their parents. They may exist as species for geologic ages, and in fact outlast their parental species. Furthermore, allopolyploids often tend to occupy areas which are newly opened to colonization by plants, and to leave their parental species in possession of the geologically older, relict areas. One effect, therefore, of changes in the earth's surface on its flora will be to eliminate the diploid species from many regions, and to leave only the more vigorous, better adapted allopolyploid species derived from them. The data on which

these postulates are based are reviewed elsewhere by the writer (Stebbins 1940, 1942, 1947a).

As pointed out by the writer in a previous publication (Stebbins 1942), this ability of allopolyploids to spread beyond and to outlast their diploid ancestors provides botanists with a new and valuable tool for studying the past history and migrations of floras. By a combination of insight and deduction, careful systematic study, and cytogenetic experimentation, we can often identify the diploid ancestors of an allopolyploid species, or at least their nearest living diploid relatives or descendants. If diploids and allopolyploid derivatives still occur together in the same region, we can assume that the latter arose under conditions essentially the same as those now prevailing. But if the present distribution of the allopolyploid proves to be different from that of its diploid relatives, and particularly if the representatives of the two original parents of an allopolyploid now occur in regions remote from each other, then we must assume that at the time when the allopolyploid arose, the distribution of these ancestral types was different from what it is at present. And by viewing the present distributions of the species concerned in the light of past events of geological history and of the distribution of fossil floras, we can often make good inferences as to the time and place of origin of the allopolyploid, and therefore of the past distribution of its parental types. The studies of Anderson (1936) on the origin of *Iris versicolor*, of Camp (1944) on that of *Oxycoccus quadripetalus*, and of Johnson (1945) on the origin of *Oryzopsis asperifolia* and *O. racemosa* are all examples of the successful use of this tool. (Stebbins 1947b).

A group of grasses particularly well suited to this type of analysis is the section *Ceratochloa* of the genus *Bromus*. Previous studies (Stebbins and Tobgy 1944) have shown that the species of this section can with one exception be divided into two series on the basis of their chromosome complements, which run parallel with certain morphological characteristics and with geographic distribution. With the exception of *B. arizonicus* (Shear) Stebbins, which has 84 chromosomes (Stebbins, Tobgy, and Harlan 1944), all of the forms native to North America which the writers had counted were octoploids with 56 chromosomes and were of allopolyploid origin. Those known from South America, on the other hand, were uniformly hexaploid, with 42 chromosomes, and although also allopolyploid, were assumed to be more ancient.

Chromosome behavior in hybrids between North American forms and those native to South America had uniformly 21 pairs of chromosomes, and 7 univalents, the latter being of larger size than the former. The chromosome formula of the South American *B. catharticus* Vahl and its relatives was given as AABBCC and that of *B. carinatus* H. & A., *B. marginatus* Nees, and their North American relatives as AABBCCLL. The set designated as L consists of seven relatively large chromosomes, corresponding in number, size, and morphology to those found in various species of the section *Eromopsis*, such as *B. laevipes* Shear, *B. vulgaris* Shear, and some forms referred to *B. ciliatus* L. Furthermore, in the diagnostic characteristics of the spikelets, particularly the lemmas and caryopses, *B. carinatus* and its relatives are intermediate between the South American Ceratochloas and the diploid species of the section *Bromopsis*. The hypothesis was therefore advanced by the writer (Stebbins and Tobgy 1944) that the octoploid North American Ceratochloas arose as allopolyploids from hybrids between ancestral species similar to *B. catharticus* and diploid *Bromopsis* species related to *B. laevipes*, *B. vulgaris*, and *B. ciliatus*.

Hybrids between Species of Sections Ceratochloa and Bromopsis

The direct testing of this hypothesis by crossing *B. catharticus* with species of the section *Bromopsis* has proved technically difficult for several reasons. In the first place, *B. catharticus*, at least under the conditions prevailing in Berkeley, shows an even stronger tendency than *B. carinatus* to produce the type of cleistogamous flowers described by Harlan (1945), and these are useless for emasculation and cross pollination. Chasmogamous flowers with large anthers are usually produced only relatively early in the season, before the beginning of the normal period of flowering of the species of *Bromopsis* available to us. Furthermore, all of the *Bromopsis* species available can be crossed with *B. catharticus* and its relatives only with the greatest difficulty. One hybrid between *B. catharticus* and *B. laevipes*, produced in 1944, proved to be a very weak plant. In spikelet characteristics it matched fairly well some forms of *B. marginatus*. It was completely sterile. Since all of the florets produced were of the cleistogamous type with small anthers, meiosis could not be studied in it. An attempt to double its chromosome number with the aid of colchicine resulted in the death of the plant. No similar hybrids have since been produced.

Another type of hybrid which could provide indirect but nevertheless strong evidence on the origin of *B. carinatus* and its relatives consists of those between these octoploids and diploid species of the section *Bromopsis*. Because of the great difference in chromosome number, success was not at first expected from such crosses. But in 1945 a single pollination of 60 florets of a strain of *B. marginatus* from Meadow View Ranger Station,

Figure 1. Typical first metaphase plate in *Bromus marginatus* × *laevipes*, no. 603–1, showing 7 large bivalents, one loosely associated medium-sized bivalent, and 19 medium-sized univalents.

Plumas County, California, with a strain of *B. laevipes* from north of Castaic, Los Angeles County, yielded two hybrid plants. Their initial growth was slow, but they bloomed freely in 1946, and in 1947 were exceptionally vigorous. They are completely sterile as to both pollen and seed. Morphologically, they resemble more nearly *B. marginatus*, but the panicle is more ample, with very numerous spikelets, and the lemmas are less carinate, and somewhat more hirsute.

These hybrids have the expected chromosome number, 35, in their somatic cells. At meiosis, the seven large chromosomes

derived from *B. laevipes* are usually paired with the L set from *B. marginatus*, and the 21 medium-sized ones are unpaired except for one to four loosely associated rod-shaped bivalents, and rarely a single bivalent with a chiasma in both arms of the chromosomes. Analysis of 50 sporocytes at first metaphase is given in table I, and a typical configuration is shown in figure 1.

Table I. Frequency distribution of sporocytes with different numbers of large and medium-sized bivalents in 50 sporocytes of *Bromus marginatus* × *laevipes*, no. 603–1.

Number of bivalents.	0	1	2	3	4	5	6	7	Total Bivalents
Frequency, L bivalents.	0	0	0	0	1	10	14	25	313
Frequency, M bivalents.	4	13	20	9	3	0	1		98

These results show that there is a strong homology between the chromosomes of *B. laevipes* and the L set of *B. marginatus*, and therefore support the hypothesis presented above as to the origin of the latter. The small amount of pairing between chromosomes of the medium-sized type is similar to that found in haploid plants of wheat (*Triticum aestivum*) and many other plants, and is probably due to the presence of duplications of segments, rather than to homology of whole chromosomes.

Nevertheless, the pairing of the L chromosomes of this hybrid is much less regular than is that of the M type in hybrids between *B. catharticus* and *B. carinatus* or *B. marginatus* (Stebbins and Tobgy 1944). The percentage of potential bivalents that are unpaired is 10.6%, or 100 times as great as in *B. catharticus* × *B. marginatus* or *B. carinatus*, and also much greater than in hybrids between *B. carinatus* and *B. marginatus*. Furthermore, the bivalents themselves are much more loosely paired than in any of the previous hybrids. Of the 313 bivalents observed, 158, or 50 per cent, are of the rod type with a single chiasma. In the hybrids between *B. catharticus* and *B. carinatus* or *B. marginatus*, only 1 to 3 per cent of the bivalents were of this type, a proportion similar to that found in *B. catharticus* itself.

These results indicate that *B. marginatus* and its relatives are allopolyploids derived from hybridization between hexaploid species of the section *Ceratochloa* related to *B. catharticus* and diploid species of the section *Bromopsis*, but these diploids were not very closely related to the modern *B. laevipes*. This explanation is also supported by the difficulty of hybridization between *B. laevipes* and *B. catharticus*. Whether other modern diploid species of *Bromopsis* are more nearly related to the ancestor of

B. marginatus than *B. laevipes* cannot be decided at present. Dr. D. D. Miller (unpubl.) found 4 to 7 per cent of the potential bivalents unpaired in hybrids involving *B. laevipes*, *B. Orcuttianus*, and *B. grandis*, while the writer (unpubl.) found complete pairing in all of 30 sporocytes of *B. Porteri* × *vulgaris*. Present evidence, therefore, indicates that the chromosomes of the modern western American species of the section *Bromopsis* may all be more similar to each other than any of them are to the *Bromopsis* genome found in *B. marginatus*.

The Relationships and Distribution of the New World Species of Sections Ceratochloa and Bromopsis.

The present distribution and relationships of the *B. carinatus* complex and its ancestors can be described as follows. The hexaploids of the section *Ceratochloa*, which contain the A, B, and C genomes, are now widespread in and endemic to the temperate parts of South America, including the entire cordillera of the Andes from Venezuela to Tierra del Fuego. Although they have been referred by some systematists to a single species, *B. catharticus* or *B. unioloides*, unpublished genetic evidence of the writer indicates that at least three or four distinct species are present. These form F_1 hybrids which are vigorous and have good pairing of the chromosomes at meiosis, but which are highly sterile. At present, there is no certainty as to which of these species is the most nearly related to the ancestor of the *B. carinatus* complex, but some evidence suggests that the species with relatively long awns, found in central Chile and the southern Andes, namely *B. stamineus* Desv. and *B. coloratus* Steud., are the most likely. These resemble *B. carinatus* much more nearly than do the short-awned types like typical *B. catharticus;* and a hybrid between *B. stamineus* and *B. marginatus* has yielded a relatively fertile allopolyploid, while the polyploids derived from hybrids between *B. catharticus* and either *B. marginatus* or *B. carinatus* are highly sterile.

The other set of ancestors of the *B. carinatus* complex, the diploid species of the section *Bromopsis*, are concentrated in western North America. As far as is known, their chromosomes are so similar that a high degree of pairing occurs in their F_1 hybrids. There are also several species of the section *Bromopsis* in South America, occurring together with the hexaploid species of section *Ceratochloa*, but those which have been investigated, and they include all of the widespread and common South American species of this section, are themselves polyploid. The number

2n = 42 was counted in cultures of *B. auleticus* Trin. and *B. uruguayensis* Arech., grown from seed sent by Sr. Bernardo Rosengurtt from Uruguay, while *B. macranthus* Desv., sent by Sr. Edmundo Pisano (no. 2014) from the Andes of Central Chile, had 2n = 28.

Measurements of the size of stomata and pollen have been made on several herbarium specimens of these and other South American species of this section, and they indicate the presence of polyploid numbers in all but two specimens. These putative diploids are *Hitchcock 22530*, from above Ollantaytambo, Dept. Cuzco, Peru, and one culm of *Hitchcock 22776*, from Pongo, Nor-Yungas, Bolivia: The specific identity of both of these specimens is uncertain.

As mentioned above, the complex of octoploids consisting of *B. carinatus*, *B. marginatus*, and their relatives are the most widespread and common native species of *Bromus* throughout western North America, from Alaska to Guatemala. The number of species present in this group has been subject to widely different interpretations by the different systematists who have treated it, and genetic evidence obtained by the writer is not helping to solve this problem. The evidence produced by Stebbins and Tobgy (1944) suggested that at least the *B. carinatus* strains of coastal California and the *B. marginatus* of Arizona are separated by barriers of almost complete hybrid sterility and should be placed in separate species. But more recently hybrids between either of these extremes and types from intermediate localities have proved to be partially fertile, and to yield offspring in the F_2 generation which are highly so. More complete data, therefore, may demonstrate that most of the strains of this octoploid complex are interconnected by forms with which they can form at least partly fertile hybrids. This situation is an anomalous one, which, so far as the writer is aware, has not been described for any other wild species. It is somewhat similar to that described by Terao and Midusima (1939), cf. Stebbins (1942b) in cultivated rice.

Several new chromosome counts have been made in this group, all of them 2n = 56. No material has yet been obtained from Alaska, but one collection made by Dr. J. Harlan near Mexico City, and another from Quetzaltenango, Guatemala, both of which are referable to *B. laciniatus* Beal, have 56 chromosomes, and the A, B, C, and L sets can be recognized in them. Every possible effort has been made to secure material of the strains of this group on which the reports in the literature of numbers lower

than 56 have been based (cf. Stebbins and Tobgy 1944), but these have been unsuccessful. In the writer's opinion, no such strains exist as native plants in North America. The number 2n = 70, reported by Nielsen (1939) for *B. marginatus* from Wyoming, has not been found either; apparently strains with this number are rather restricted in distribution.

The occurrence in South America of species of *Bromus* having 56 chromosomes and the constitution AABBCCLL was discovered in a seed sample received as *B. coloratus* Steud., from Sr. Bernardo Rosengurtt of Juan Jackson, Uruguay, and originally collected in the Nahuel Huapi National Park, in the Andes of southern Argentina. Comparison of plants grown from these seeds with a large series of specimens borrowed from the U. S. National Herbarium through the kindness of its curator, and with the helpful assistance of Mrs. Agnes Chase, showed that they differ in several respects from typical *B. coloratus*. Characteristic plants of the latter species were grown from another seed sample sent by Sr. Rosengurtt, and were found to have 42 chromosomes and the AABBCC constitution typical of South American representatives of the section *Ceratochloa*. The octoploid from Nahuel Huapi, on the other hand, resembles in its habit, inflorescence, and lemmas specimens from Bolivia (Sorata, 4000 m., Lacatia, *Günther 85;* Sorata, *Holway 552*) which were identified by Dr. A. S. Hitchcock as *B. pitensis* H. B. K. Both these Bolivian specimens and several of typical *B. pitensis* from Ecuador agree with the octoploid from Nahuel Huapi as well as *B. carinatus* and other North American octoploids in the size of their pollen grains and stomata, which are larger than those of the South American hexaploids. It is likely, therefore, that a complex of octoploids with the constitution AABBCCLL exists in the Andes from Ecuador to southern Argentina, which may for the present be placed under the oldest name applied to them, *B. pitensis*. Judging from specimens, however, they are uncommon and very locally distributed except in Ecuador and northern Peru, where typical *B. pitensis* appears to be abundant. In Colombia they are replaced by forms which are apparently indistinguishable from the Mexican and Central American *B. laciniatus*.

An indication of the relationship of these South American octoploids with the North American ones is provided by a hybrid obtained between the *B. pitensis* from Nahuel Huapi and a strain of *B. marginatus* obtained from the nursery of the U. S. Soil Conservation Service at Ames, Iowa, no. M2–9435–42,

which came originally from Colorado. This hybrid was highly sterile and showed much more chromosomal irregularity at meiosis than did any of the hybrids between different North American octoploid types. Among 42 sporocytes analyzed at first metaphase, only 10 had the expected 28 bivalents. Of the remainder, 27 had from 2 to 6 unpaired univalent chromosomes, and 5 had 26 pairs plus a ring or chain of 4. Lagging chromosomes were found in 41 out of 60 sporocytes at first anaphase, and a comparable proportion of tetrads contained extra nuclei or extruded chromatin. Bridge-fragment configurations, resulting from heterozygosity for inversions, were found in 15 sporocytes, or 25 per cent.

A more significant fact is that these irregularities were about ten times as frequent among the large as among the medium-sized chromosomes. Table 2 shows this difference.

Table 2. Relative frequency of meiotic abnormalities in large and medium-sized chromosomes in *Bromus pitensis* × *marginatus*.

	Large Chromosomes	Medium Chromosomes
Number potential bivalents unpaired	35	10
Per cent potential bivalents unpaired	11.9	1.1
Number bivalents with one chiasma	70	20
Per cent bivalents with one chiasma	23.8	2.3
Per cent bivalents with bridge-fragment configurations	3.6	0.24
Per cent chromosomes lagging at I anaphase	13.1	1.5

Such differences are strong evidence against the hypothesis that *B. marginatus* and *B. pitensis* had a common origin and have diverged relatively recently. Both are allopolyploids derived from hybrids between diploid species of section *Bromopsis* and hexaploids of section *Ceratochloa*, but the *Ceratochloa* parents of these two allopolyploids must have been relatively closely related to each other, and the *Bromopsis* parents much more distantly so. That even the A, B, and C sets of *B. pitensis* are not the same as those of *B. marginatus* is evident from the presence of some irregularities of pairing among the chromosomes of this type, and in particular of the occasional ring or chain of 4 chromosomes, indicating heterozygosity for a translocation involving A, B, or C type chromosomes.

Probable Place and Time of Origin of the North American Octoploids and Its Implications

The data presented above make highly probable the assumption that in both North and South America hexaploid species of the section *Ceratochloa*, with the constitution AABBCC, have some time in the past independently hybridized with diploid species of the section *Bromopsis* to produce octoploids similar to *B. carinatus*, *B. marginatus*, and *B. pitensis*. The origin of the South American types cannot be discussed until more is known about them. That of the North American ones is complicated by the fact that only their *Bromopsis* parents occur at present within their range of distribution. *B. catharticus* is found as a recently introduced weed in some parts of this range, but *B. carinatus* and *B. marginatus* were known and recognized before this introduction occurred. The wide distribution of the North American octoploids, and the varied habitats in which they occur indicate that they have been here a long time.

We are forced to conclude, therefore, that some time in the past there existed in western North America as native plants hexaploid species of the section *Ceratochloa* closely related to *B. catharticus*, *B. stamineus*, and *B. coloratus*. The time when this might have occurred is suggested by the studies of Elias (1942) on the fossil grass fruits of the tribe *Stipeae* found by him on the Great Plains. Among such fruits of mid-Pliocene age is a species of the genus *Nassella*, which is now confined to the South American Andes. In addition, the writer has shown elsewhere (Stebbins 1947b) that the bulk of the fruits collected by Elias in deposits of mid-Pliocene age and referred by him to the fossil genera *Stipidium* and *Berriochloa* resemble closely modern species of the genus *Piptochaetium*, subg. *Podopogon*, nearly all of which are now confined to the pampas of eastern South America (Parodi 1944). Seeds of *Bromus*, since they lack the indurated lemma possessed by the *Stipeae*, could not easily become preserved as fossils. But the demonstration that the majority of the known fossil species of grasses of the Pliocene epoch in western North America have their closest living relatives in South America suggests that the same situation was very likely true in *Bromus*, and that at this time hexaploid species of the section *Ceratochloa* occurred here and hybridized with diploid species of section *Bromopsis* to produce the octoploids of the *B. carinatus* complex.

The two problems which remain to be considered are first, the origin and distribution of the hexaploid Ceratochloas, and second

the reasons for their extinction in North America. Cytological evidence from several sources indicates that these hexaploids are themselves allopolyploids, derived from hybridization involving three different original diploid species. None of these diploids has yet been found, and examination of stomatal size in a large series of specimens of sect. *Ceratochloa* from South America borrowed from the U. S. National Herbarium failed to reveal any with the small stomata which one would expect in such diploids. These diploid ancestors, therefore, may well be extinct. The evidence from hybrids between different North American octoploids (Stebbins and Tobgy 1944) suggests that the latter arose independently from related but not identical parents, and therefore that more than one ancestral hexaploid may have existed in North America during the Tertiary period. We cannot conclude, therefore, that the present center of distribution of these hexaploids in South America is necessarily the original one, from which they migrated to North America. The only assumption which can be safely made on the basis of the data now available is that during the Pliocene epoch the hexaploid species of *Bromus*, section *Ceratochloa* had either a continuous distribution from temperate western North America to temperate South America, or more probably a bipolar distribution in the temperate zones of the two continents. This latter pattern of distribution is well known in many modern groups of plants, and has been carefully discussed by Johnston (1940) and DuRietz (1940). Its explanation is not yet certain. Both the ancestry and place of origin of the hexaploids, therefore, are at present uncertain.

Two reasons can be suggested for the extinction of the hexaploids in North America during the Pleistocene epoch. In the first place, the climate of temperate North America, because of the greater land mass present, has a much more continental character than that of corresponding latitudes in South America, with lower minimum temperatures in winter, and higher ones in summer. Most of the hexaploid types now existing are adapted to relatively mild winters, and have flourished best as introduced plants chiefly along the Gulf Coast of the southeast, and the coast of California. The climate of western North America during parts of the Pleistocene epoch was more continental than at present, but it may very well have been milder during the Tertiary period, due to the lower elevation of the western Cordillera, and the more extensive ameliorating influence of the Pacific Ocean. The severity of the climate brought on by the Pleistocene

glaciation, therefore, was probably one cause for the extinction of hexaploid species of the section *Ceratochloa* in North America. A second cause may very well have been competition with the vigorous octoploid types which had been newly evolved. These now have "weedy" tendencies, and even in the forested areas spread along roadsides and other areas of disturbed ground. Huskins (1931) has noted the tendency of the newly evolved allopolyploid species *Spartina Townsendii* to drive out its progenitor, *S. maritima*, wherever these two species come into contact with each other. Both of these causes probably contributed to the extinction of the hexaploids, and no decision can be made as to which was the more important.

There is little doubt that other allopolyploids now dominant in North America will be found to be derived from ancestors at present endemic to South America. Their discovery will be a valuable tool for determining the present and past relationships between the floras of the two continents.

SUMMARY

The nature of chromosome pairing in hybrids between *Bromus carinatus* H. & A. or *B. marginatus* Nees and *B. catharticus* Vahl as well as between *B. marginatus* and *B. laevipes* Shear provides strong evidence that the octoploid North American species of *Bromus*, section *Ceratochloa* of which *B. carinatus* and *B. marginatus* are the best known, originated through allopolyploidy involving hexaploid species of section *Ceratochloa*, for which the genome formula AABBCC is used, and diploid species of section *Bromopsis*, having the formula LL. The octoploid South American forms of section *Ceratochloa*, which are tentatively grouped in the species *Bromus pitensis* H. B. K., arose in a similar manner, but independently. Chromosome pairing in *B. pitensis* × *marginatus* indicates that the A, B, and C genomes of these two species are relatively similar, and therefore that their ancesters in section *Ceratochloa* were closely related, but their L genomes are much more dissimilar, so that their *Bromopsis* ancestors were rather distantly related to each other. Since at present no hexaploid species of the section *Ceratochloa* is native to North America, the distribution of these hexaploids must have been more widespread at the time when *B. carinatus* and *B. marginatus* originated by hybridization and allopolyploidy than it is at present. Evidence from the distribution of fossil *Stipeae* and from the probable nature of the climate in the middle and later part of the Tertiary period suggests that at some time during

this period the hexaploid *Ceratochloa* species and the diploid species of section *Bromopsis* occurred together in western North America. There they hybridized, and their sterile hybrids gave rise by doubling their chromosome numbers to the ancestors of *B. carinatus*, *B. marginatus*, and their relatives. With the onset of the Pleistocene ice age, and because of competition with the more aggressive, newly formed octoploids, the hexaploids became extinct in North America, persisting only in temperate South America, where climatic conditions changed less.

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ENDEMISM IN THE FLORA OF CALIFORNIA

By ALICE EASTWOOD

The most conspicuous feature of the flora of California is the endemism that marks it as distinct from that of most parts of the world. Because of the close inter-relationship among many genera and species, it is puzzling and interesting. Evolution still seems to be progressing since distinctive limits are often so uncertain.

As it would be impossible and impractical to name or even enumerate the endemic species in many genera, because of the diversity of opinion as to criteria for specific limits, the genera only will be considered.

The plan is to take these genera in the order in which the families of plants native in California are generally arranged. Of course, state boundaries mean nothing to plants and it is to be expected that genera distinctly Californian will have species crossing the border. The northern part of Lower California is similar to and really ecologically a part of San Diego County. A similar situation occurs in the adjacent counties of Del Norte, the most northern in California along the coast, and Curry and Josephine counties in southern Oregon. Desert plants cross over into Arizona and Nevada. Nevada also has some of the California species on the east side of the Sierra Nevada boundary.

Among the ferns and fern allies no endemic genera occur. In the Gymnosperms, *Sequoia* Endl. is the only one, with two species growing in limited areas in California, the coast species, *S. sempervirens* (Lamb.) Endl. extending into southern Oregon, adjacent to Del Norte County. This genus was represented in preglacial times by many species in the Northern Hemisphere where their fossil representatives have been unearthed. With the Sequoias are also *Torreya* Arn., *Lithocarpus* Sarg. and *Umbellularia* Nees. The two former have widely separated species

in the Northern Hemisphere, the last related to *Ocotea* Aubl., a genus of *Lauraceae* with a wide distribution chiefly in the Southern Hemisphere; *Umbellularia* extends north into Pacific coastal areas.

Among the families of the Monocotyledons, *Liliaceae* is the only one with endemic genera, namely, the monotype *Odontostomum* Torr., *Muilla* S. Wats. and *Chlorogalum* Kunth, the last two with several species. *Stropholirion* Torr. has two species, one exclusively Californian and the other in Del Norte County and the adjacent counties of Oregon.

The *Brodiaea* group of inter-related genera is essentially Californian, although represented by a few species in neighboring states. The following genera have been considered distinct: *Bloomeria* Kell., *Calliprora* Lindl., *Hesperoscordum* Lindl., *Triteleia* Lindl., *Hookera* Salisb., *Stropholirion* Torr., *Brevoortia* Wood and *Dichelostemma* (Torr.) Wood. Whether or not any agreement can eventually be attained as to the status of these genera, the group is essentially Californian. *Allium* L., *Lilium* L., *Calochortus* Pursh and *Fritillaria* L. are rich in endemic species.

Among the *Apetalae, Polygonaceae* alone has endemic genera, namely: *Nemacaulis* Nutt., *Hollisteria* S. Wats. and *Gilmania* Coville. All are monotypic. *Eriogonum* Michx., *Chorizanthe* R. Br., *Oxytheca* Nutt. and *Polygonum* L. abound in endemic species. Many species, especially of *Eriogonum* and *Chorizanthe*, become conspicuous in the landscape where they monopolize an area, giving color or a filmy effect that is very lovely.

The greatest number of families is in the *Choripetalae. Portulacaceae, Caryophyllaceae, Ranunculaceae* and *Berberidaceae* have no genera restricted to California.

Oreobroma Howell, of the *Portulacaceae*, segregated from *Lewisia* Pursh, has many beautiful species, especially from the Northern California-Southern Oregon region. Known in gardens as Lewisia, they are among the choicest and most beautiful rock-garden plants. *Paeonia* L., a genus well known in cultivation, belonging to the *Ranunculaceae*, has two species in California, but is not found elsewhere in the western hemisphere, so it would seem to be one of the preglacial survivors. Endemic species occur in many genera of the *Ranunculaceae*, especially in *Delphinium* L. *Vancouveria* Morr. & Decne. and *Achlys* DC. of the *Berberidaceae* are Pacific Coast endemics and occur in California only in the northern part.

Endemism predominates in the *Papaveraceae* in both genera

and species. Monotypic are *Canbya* Parry ex Gray and *Stylomecon* G. Taylor. The latter has been referred to *Papaver* L. and *Meconopsis* Vig. Diss. (ex DC.). The endemic genera represented by several closely related species are *Romneya* Harvey, *Dendromecon* Benth., *Hesperomecon* Greene and *Meconella* Nutt. Several of these genera have species crossing into adjacent states, but they are essentially Californian. The evolutionary urge is strongly marked in this family, especially among the species. E. L. Greene in Pittonia V. describes with elaborate keys 122 species of *Eschscholzia* and 52 of *Platystemon*. Both Jepson and Abrams recognize only seven of *Eschscholzia* and but one *Platystemon*.

Tropidocarpum Hook. and *Stanfordia* S. Wats. seem to be the only genera of *Cruciferae* not found outside California. *Heterodraba* Greene crosses the northern and southern boundaries but seems like a California endemic. *Draba* L. and *Arabis* L. have endemic species, but in *Streptanthus* Nutt. the number is remarkable and many are restricted to a small and limited area. The species seem to be in transition. In Vol. 1, Leaflets of Botanical Observation, E. L. Greene segregates *Streptanthus* into four Californian endemic genera and five more widely distributed. These of course overlap but indicate the remarkable inter-relationship.

Formerly included in *Sedum* in the *Crassulaceae*, but now considered distinct genera by some authors, are *Sedella* Britt. & Rose, *Hasseanthus* Rose and *Gormania* Britt., the two former restricted to California, the last more widely distributed. *Dudleya* Britt. & Rose and *Stylophyllum* Britt. & Rose are now classified as distinct. They have been included in *Cotyledon* L., a South African genus, and *Echeveria* DC., common in Mexico. While both cross state boundaries, and *Dudleya* has many species in Lower California, they are truly Californian endemics. The many species are so closely related that they are very difficult to distinguish and indicate a state of transition.

Among the many genera of *Saxifragaceae*, *Jepsonia* Small and *Peltiphyllum* Engler, both formerly included in *Saxifraga* L., are considered to be endemic; the former runs into Lower California and the latter into Oregon. *Bensonia* Abrams and Bacigalupi, a monotypic genus in southwestern Oregon, has not yet been found in California. Among the *Grossulariaceae* are many California endemics. In the *Philadelphus* group, *Carpenteria* Torr., a monotypic genus, is restricted to a limited area of the foothill

region of Fresno County. In almost all of the genera, endemism prevails among the species and several subdivisions of the old genera have been given generic rank in recent publications.

Rosaceae has but few endemic genera. *Lyonothamnus* Gray is restricted to the islands off the coast of Santa Barbara. The monotypic *Chamaebatia* Benth. forms a lovely ground-cover with flowers like a strawberry, fern-like leaves which have a viscid pubescence and a strong odor. *Adenostoma fasciculatum* H. & A. covers great areas and gives distinct color as it is a dominant shrub in the chaparral. The other species, *A. sparsifolium* Torr., is more tree-like, a species of Southern California which extends into Lower California. *Photinia* Lindl., a genus represented by many species in China and Japan, is considered by some botanists to include the Californian genus *Heteromeles* M. Roem. They are certainly closely related and the California plant so well known as Christmas berry is probably another preglacial survivor.

The California Pitcher Plant, *Darlingtonia californica* Torr., contrary to its name, is more abundant in southern Oregon. I have seen it in many widely separated localities in California but never in such rich abundance as in coastal Lane County in southern Oregon. Over acres of a marshy area, nothing could be seen but these pitcher-like leaves and the beautiful crimson and yellow open flowers on their long stems.

But one endemic genus, the monotypic *Pickeringia* Torr., is in the *Leguminosae*. This is a shrub with gray-green foliage, spiny stems and lovely crimson flowers, which inhabits the chaparral areas only. *Trifolium* L., *Lupinus* L. and *Astragalus* L. are remarkable for the number and complexity of the species. Great differences of opinion as to specific limits result, but in California many are truly distinct and endemic. The plants now included in the European genus *Lotus* L. were formerly classified by some authors under *Hosackia* Dougl. and *Syrmatium* Vog. These two genera are Californian endemics, although a few species cross the borders. The species are closely related. Among several families following, endemic genera are rare. Species of *Linum* L. are almost all endemic. *Cneoridium* Nutt., a monotypic genus of the *Rutaceae*, is endemic in the San Diego-Lower California region. The *Euphorbiaceae* have no endemic genus and the species are fairly well distributed. *Limnanthes* R. Br. has endemic species chiefly in California and Oregon. It belongs to the *Limnanthaceae*, a family of two genera, formerly classed with the *Geraniaceae*. *Rhamnaceae* has but one endemic

genus, namely *Adolphia* Meisn., monotypic in San Diego and Lower California. *Rhamnus* L. has two species with many varieties that have been considered species by some authors. In *Ceanothus* L., the number, complexity and beauty of the many species give the greatest interest to taxonomists among whom there has, so far, been no agreement. They are among the loveliest shrubs in California and many species monopolize areas to which they give color and character.

With the exception of *Malacothamnus* Greene, which was included in *Malvastrum* by Asa Gray, no genus is endemic in *Malvaceae*. However, *Lavatera* L. has especial interest because of its distribution. A few endemic species occur on the islands off the coast of Southern and Lower California, the other species only in the Mediterranean region and Canary Islands, so that it would seem to be one of the preglacial survivors. *Sidalcea* Gray has many endemic species.

Fremontia Torr. represents the *Sterculiaceae* with several closely related species, one extending into the northern part of Lower California and one into Arizona. In the families that follow, no endemic genera occur. *Viola* L. has endemic species, *Frankenia* L. has two, *Helianthemum* Pers. related species and doubtful, *Hypericum concinnum* Benth. the only one in that family. Among the *Loasaceae* no endemic genera occur, but *Mentzelia* has several endemic species, some of uncertain status owing to close relationship.

Many genera, some endemic, have been included by Munz in *Oenothera* L. and within the group endemic species occur. *Epilobium* L., *Zauschneria* Presl, *Clarkia* Pursh and *Godetia* Spach are well represented by endemic species. *Cactaceae* are restricted to southern California and there are no endemics in the state.

Rubiaceae, Caprifoliaceae, Valerianaceae and *Campanulaceae* have no genera found only in California, but endemic species occur in all. In *Rubiaceae* there are many galiums. *Lobeliaceae,* by some authors included in *Campanulaceae,* has *Palmerella* Gray and *Parishella* Gray, the latter passing into Lower California. *Downingia* Torr. and *Nemacladus* Nutt. are in bordering states but have several inter-related endemic species. The former is a feature of the hog-wallows, those depressions which become shallow pools in the rainy season and dry up when the rains cease. They are frequent in the great valleys of California and often will be filled exclusively with one species of *Downingia,* clothing the area with a mantle of blue. Species of *Allocarya* of the *Boraginaceae* also love these depressions and when exclusive

color the ground white. *Mimulus* of the *Eunanus* section, of the *Scrophulariaceae*, is a lovely crimson. Each depression, too, may exhibit slight differences in the same species from others in hog-wallows in the same region.

Lennoaceae is a family of root-parasites with monotypic genera native in southern California, *Pholisma* Nutt. in the San Diego-Lower California region, and *Ammobroma* Torr. abundant in Mexico. *Ericaceae* and *Vacciniaceae* have no endemic genera. The species in *Arctostaphylos* L. are numerous and inter-related. Some species occur over extensive areas, sometimes exclusive and forming an especially Californian effect in the landscape. *Arbutus* L. has species in California, Arizona and Mexico, but otherwise is unknown in North America. Other species are in the Canary Islands and Mediterranean region and this distribution suggests preglacial occurrence. Several genera, such as *Comarostaphylis* Zucc. and *Xylococcus* Nutt. in the San Diego-Lower California area, are intermediates and have been included in *Arctostaphylos* by some authors.

The *Monotropaceae* have genera endemic in the Pacific Coast states but none is exclusively Californian. These are *Sarcodes* Torr., *Newberrya* Torr., *Pleuricospora* Gray and *Allotropa* T. & G.

Primulaceae has endemic species in *Dodecatheon* but no endemic genera. *Primula suffrutescens* Gray of the alpine zone is a woody-based species in a genus of chiefly herbaceous plants. *Plumbaginaceae*, *Styracaceae*, *Oleaceae* and *Gentianaceae* have no endemic genera. In *Gentianaceae*, *Centaurium* Hill, *Gentiana* L. and *Swertia* L. have endemic species. *Apocynaceae* has only one endemic genus, the lovely *Cycladenia* Benth.; *Asclepiadaceae* also only one, *Solanoa* Greene, which Gray included in *Gomphocarpus* but Jepson considers distinct. Several endemic species are in *Asclepias*. The species in *Convolvulus* are in a state of uncertainty and there are no endemic genera in the family.

In the *Polemoniaceae*, the diversity of opinion is due to the inter-related genera that have at one time all been included in *Gilia*. However, none is exclusively Californian but the numerous species in all entities and the beauty and abundance of the flowers over many areas produce one of the loveliest features in the landscape.

No endemic genera are in *Verbenaceae*, and only *Acanthomintha* Gray in *Labiatae*. The species in *Monardella* Benth. are variable and limits often indefinite; but some endemic species are quite distinct. *Audibertia* Benth., now included in *Salvia* L., is a common bee-plant in California. Many species of *Salvia*, most

of them endemic, are very abundant over areas where they give character to the landscape. *Antirrhinum* L., *Penstemon* Mitch., *Orthocarpus* Nutt., *Castilleja* Mutis, *Mimulus* L. and *Collinsia* Nutt. of *Scrophulariaceae* are rich in endemic species, some with innumerable individuals that color the ground, but the family has no endemic genus.

Among the *Hydrophyllaceae*, monotypic *Lemmonia* Gray and *Draperia* Torr. are endemic. Lincoln Constance in Madroño V. has made some changes in *Ellisia* L. and *Nemophila* L. He has restored *Eucrypta* Nutt., a monotypic endemic, formerly *Ellisia chrysanthemifolia* Benth. Into the genus *Pholistoma* Lilja he transfers *Ellisia membranacea* Benth., *Nemophila aurita* Lindl. and *N. racemosa* Nutt. These, if eventually adopted, will be endemic although *N. racemosa* is also in northern Lower California. *Phacelia* Juss., *Nemophila* Nutt. and *Eriodictyon* Benth. are rich in endemic species, abundant also in individuals wherever growing and a very noticeable feature in landscape coloring, often recognizable from afar.

The greatest diversity exists among authors as to the limiting factors in closely related genera in *Boraginaceae*. None of these entities, however, is restricted to California, but they are a perplexing problem. Among species, too, there is difficulty. *Amsinckia* Lehm. is the most hopeless. Wm. M. Suksdorf, in a revision in German, published at his own expense, describes more than 200 species. The four sections in which he places them seem fairly distinct from the character of the nutlets, and perhaps the only present solution is to reduce them to the four sections: *A. intermedia* F. & M. representing *Muricatae; A. spectabilis* F. & M., *Microcarpae; A. Douglasii* DC., *Tessellatae;* and *A. vernicosa* H. & A., the *Vernicosae.*

Endemic genera in the *Compositae* are fewer than one would expect in this large family. The following list includes all:

Pentachaeta Nutt. Southern to middle California.
Lessingia Cham. From northern to southern California and with one species in Arizona.
Corethrogyne DC. From southern to northern California and extending into Oregon along the coast.
Whitneya Gray. Monotypic perennial, a mountain species.
Venegasia DC. Monotypic perennial, Santa Barbara and southward.
Monolopia DC. Middle and southern California with several species.
Blennosperma Gray. Monotypic annual in wet places in middle California.
Crockeria Gray. Monotypic annual in alkaline areas, chiefly in the San Joaquin and Kings River Valleys.

Eastwoodia Bdg. Monotypic shrub in areas adjacent to the San Joaquin Valley and other hot areas in middle California.
Tracyina Blake. Monotypic in northern California.
Phalacroseris Gray. A mountain monotype.
Raillardella Gray. A mountain genus also in Nevada on the Sierra Nevada boundary.

The plants known in California as tar-weeds are very common. The following genera, which were formerly included in *Hemizonia*, are considered to be distinct by some authors, namely: *Centromadia* Greene, *Calycadenia* DC., and *Blepharizonia* (Gray) Greene. All are endemic. *Madia* Mol. is also South American with one similar species. *Hemizonella* Gray, of this group, is a small annual but not exclusively Californian.

Most of the genera of *Compositae* are widely distributed but many endemic species are among them.

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VAUCHERIA SCHLEICHERI IN NORTH AMERICA

By Jules Brunel

In 1895, the Belgian botanist Émile de Wildeman, studying the Algae of J. Cl. Schleicher's herbarium at the University of Lausanne, found a new species of *Vaucheria*, which he named *V. Schleicheri* (1), after the name of the collector, a Swiss botanist who lived in the first decades of the 19th century. A good plate accompanied this original description.

Wildeman naturally knew nothing of the habitat of the new species, the label accompanying the specimen bearing only these words: *Conferva amphibia* γ *lucida. In fossis Vallesiae et Noville.* But he supposed it might have been collected in saline water, because there are salt springs in that part of the Valais where Schleicher lived and collected (fig. 1).

Heering (2), in 1921, included *V. Schleicheri* in his Siphonales of Central Europe, but his treatment is based entirely on the original description, nobody having found the plant again anywhere during the period 1895–1921. Wildeman's description and figures were carefully copied by Heering and an adequate key to species was prepared, enabling one to identify the plant with ease and certainty. The only difference between Wildeman's and Heering's descriptions lies in the fact that, whereas the former inferred that the habitat was inland brackish water, the German author affirmed that *V. Schleicheri* grew

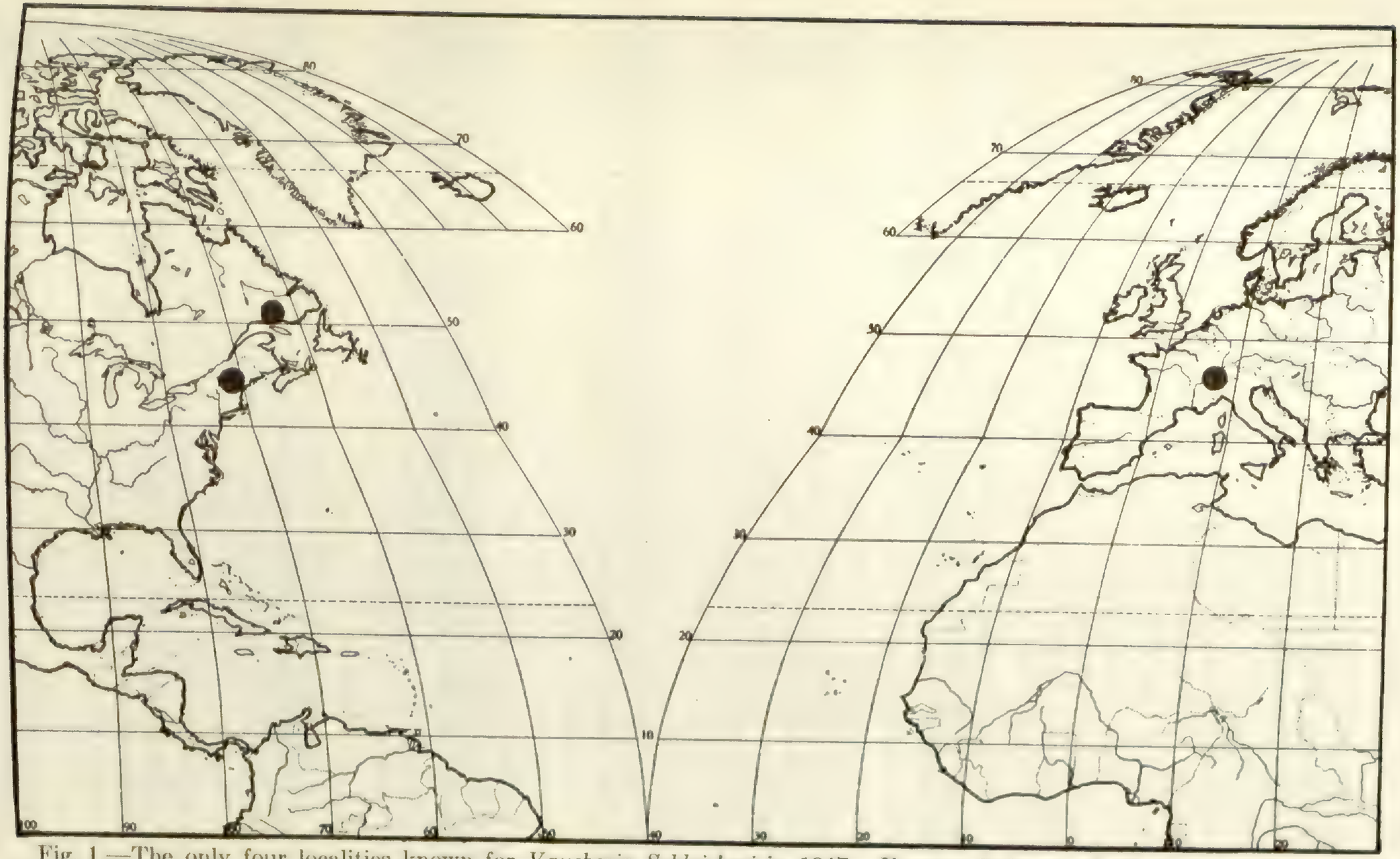

Fig. 1.—The only four localities known for *Vaucheria Schleicheri* in 1947. Europe: Switzerland (Valais) and France (lac d'Annecy, near the Swiss border). America: United States (Connecticut River) and Canada (Mingan River). Base map from Goode's series, copyrighted and published by the University of Chicago Press.

in salt water: "Schweiz in Gräben mit salzhaltigem Wasser im Wallis und bei Noville."

It is only in 1925 that the plant was collected again, and that something definite could be learned about the habitat of this rare *Vaucheria*, which we now know as a distinctly freshwater species. Pierre Dangeard, while dredging in the lac d'Annecy, in France near Geneva, about 35 miles west of the Swiss border (fig. 1), brought up from a depth of 60 feet, in three different points, an abundance of *Vaucheria Schleicheri*, which was found to be sterile in the fall, but fertile in the month of July.

With this material in hand, Dangeard (4, 7) was able to rewrite and complete the original description, especially as regards the oospore, which Wildeman had not seen, and which was found to be spherical and with a brownish wall. He also gave a different explanation of the dehiscence of the antheridium, a subject which we shall discuss later. In 1929, Helen Jean Brown, in her monograph of the Vaucheriaceae (5), reproduced Heering's description and figures of *V. Schleicheri*, Wildeman's original paper not having been available to her. Unfortunately, Heering's figures (already copied from Wildeman) were considerably distorted in this second process of copying, and there are glaring discrepancies between the dimensions of the various organs as given in the text, and as they can be computed from the figure. I feel certain that no collector could ever identify *Vaucheria Schleicheri* with the help of Miss Brown's illustration only.

Schleicher's original collection, and Dangeard's, were made in close localities, only about fifty miles distant one from the other.

After 1925 the plant was not found again until 1937, when Miss Hannah Croasdale collected it, for the first time in North America, below Wilder Dam, in the Connecticut River, near Hanover, New Hampshire (fig. 1). This collection was reported the next year by Prescott (6).

While studying various collections of Algae I had made in 1939 on the north shore of the Gulf of St. Lawrence, I was agreeably surprised to see that I had brought back from the Mingan River (fig. 1) a pure and fertile collection of that very rare species, made on 30 August 1939.

The plant was growing under about two feet of clear, running, fresh water, in sight of the first fall of the river—a habitat very similar to that in the Connecticut River, but very different from that in the lac d'Annecy (under 60 feet of water). Furthermore, the water was not cold, as must have been the case in the depths of the French lake.

Thanks to Dr. Prescott's kindness, I compared the New England material with mine from Mingan, and there is no doubt that the two plants are similar. On the other hand, the illustrations which accompany Wildeman's and Dangeard's descriptions enable us to identify with certainty the American and the European plants.

The precise spot where my Mingan collection was made was not far from the salt water of the Gulf, as I went up the river only a few miles, in a row-boat. But I found a confirmation of the freshness of the water in the presence, on the filaments of *Vaucheria*, of epiphytic Algae which, as far as I know, never tolerate the slightest salinity: *Oedogonium*, *Bulbochaete*, etc.

Vaucheria Schleicheri is a monoecious species, very neatly characterized by its big filaments (up to 180 μ in diameter), its spherical and sessile oogonia (up to 340 μ in diameter), its ovoid and sessile antheridia, parallel or nearly so to the filament, and forming groups of four or five at the proximity of each oogonium.

My observations have enabled me to complete, to correct and to confirm, on several points, the diagnoses of Wildeman and Dangeard. I must point out that my observations were made on material kept in 5% formaldehyde for several weeks. The contents of the filaments has not been shown in the accompanying plate, but the antheridia drawn empty were really so.

VEGETATIVE STRUCTURES

Cell wall.—The fortuitous presence of the broken end of a filament in the microscope field allowed me to determine the dual nature of the cell-wall (fig. g), the outer wall being slightly tinged with yellow, while the inner wall was absolutely hyaline.

Inner cellulose (?) thickenings.—P. A. Dangeard in a paper on "La structure des Vauchéries" (3, p. 249) reports that in *Vaucheria sessilis* DC., a subaerial species, "on rencontre parfois à l'intérieur des filaments des sortes d'épaississements internes de la membrane sous la forme de colonnes plus ou moins recourbées; elles présentent une sorte d'axe central et les stries nombreuses indiquent le mode de croissance; ces formations ont dû être signalées déjà: aussi je n'insiste pas."

These stratified thickenings, which had not yet been found in *Vaucheria Schleicheri* were observed in the material from the Mingan River (fig. h). The origin and significance of these structures are not yet well understood. The filament illustrated here had a definite constriction near the zone of inside thickenings. Whether there is any connection between these two phenomena is a matter of conjecture.

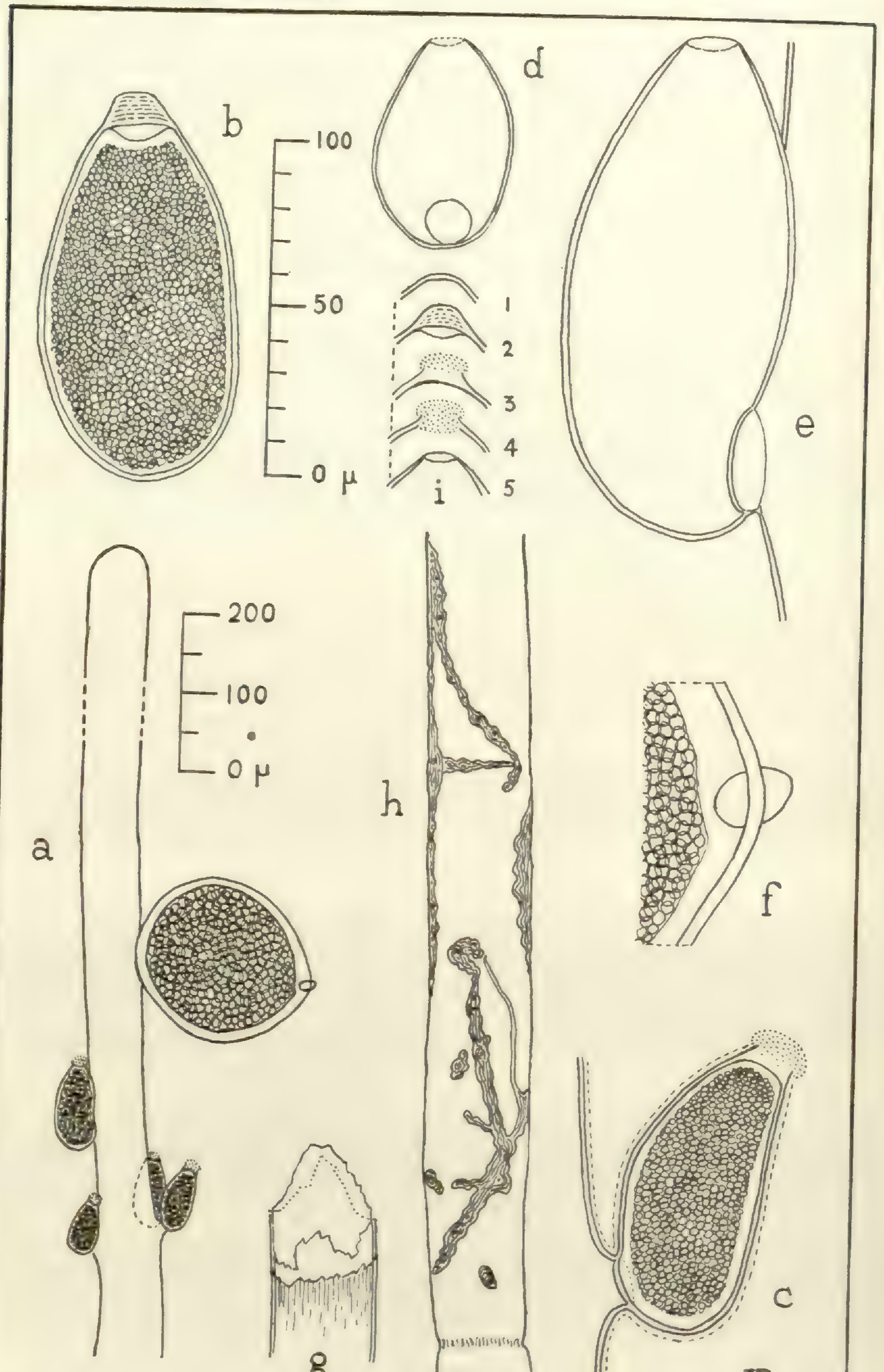

Fig. 2, VAUCHERIA SCHLEICHERI De Wild.

REPRODUCTIVE STRUCTURES

Oogonium.—The spherical oogonium is said by Pierre Dangeard (7, p. 194) to bear "à maturité une papille saillante à son sommet." I cannot say that I have observed such a papilla, but in at least one oogonium I have seen there was a definite, hyaline, egg-shaped gelatinous plug, measuring about 22 x 15 μ. I cannot say how this plug originates, but it was definitely there (fig. a and f). Furthermore, it was still easier to observe under high power (fig. f) because the contents of the oogonium had slightly contracted in the preservative fluid, leaving a clear zone underneath the cellulose membrane, and disclosing that part of the plug inside the oogonium.

Antheridium.—As my material contained many antheridia, full or empty, I measured twenty-three and could thus determine that functional antheridia may be much shorter than the measurements given by Wildeman and Dangeard seem to indicate, i. e. 62–150 μ as against 140–170 μ. The smallest and the largest functional antheridia observed are shown on the accompanying plate (fig. d and e).

Another matter relating to antheridia is that of their dehiscence. Wildeman had already observed that some antheridia, still full of sperms, were closed by a thin diaphragm only and that a stopper of some sort, above that diaphragm, was gone, leaving a saucer-shaped head. This mode of dehiscence prompted him to write that *V. Schleicheri* "possède dans l'anthéridie une particularité non encore rencontrée dans les autres espèces du genre" (1, p. 589).

Dangeard's observations, performed on living specimens, confirmed Wildeman's assumption that the diaphragm disappears suddenly towards the end of the dehiscence. He writes: "La déhiscence de l'anthéridie est due à la formation à son sommet d'un bouchon gélatineux formé par gélification de la paroi qui se dissout ensuite dans sa région externe, puis, peu de temps après, dans sa région interne constituant une sorte de diaphragme dont l'existence n'est que momentanée."

I have illustrated (fig. i, 1–5) the sequence of the phases of antheridial dehiscence as most of them can be observed on a large enough number of mature antheridia. Phase 2 corresponds to fig. b, phase 3 to fig. c, phase 5 to fig. d and e. Phases 1 and 4 were not actually seen, but it is evident that the process begins with a plain smooth cellulose membrane. Phase 4 is probably of very short duration, disappearance of the inner diaphragm being the last stage in the gelatinization of the "stopper" and very likely determining the sudden dehiscence of the antheridium and eruption of sperms.

I have not observed that the cellulose callus bears any internal conical outgrowth, as stated by Dangeard, but it is very likely that the process described and illustrated by the French botanist corresponds with the depressed diaphragm in my fig. b.

Table I gives comparative measurements of various parts of the plant. The four localities known at present are represented, but I am responsible for measurements of both the U. S. and Canadian material.

TABLE I

		Switzerland (Wildeman) 1895	France (Dangeard) 1925	U. S. A. (Croasdale-Prescott) 1937	Canada (Brunel) 1939	Extremes
Filaments:	diameter	120–180 μ	120–170 μ	128–194 μ	80–168 μ	80–194 μ
Oogonia:	diameter	280–340 μ	280–340 μ	.....	210–330 μ	210–340 μ
Antheridia:	length	140–170 μ	140-170 μ	97–167 μ	62–150 μ	62–170 μ
	diameter	47–80 μ	50–80 μ	48–63 μ	40–80 μ	40–80 μ
	aperture (diam.)	18 μ	8–15 μ	.....	12–21 μ	8–21 μ

Conclusions

From an ecological standpoint, it may be concluded that *Vaucheria Schleicheri* is a definitely freshwater species, but not strictly confined to deep waters as stated by Pierre Dangeard, since in both American localities it was growing under a few feet of water only.

Cytologically, our observations enable us to conclude that *V. Schleicheri* belongs to that group of species with chloroplasts devoid of pyrenoids, a point which had not yet been settled, and that we have been able to verify on both North American collections.

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Explanation of Figure 2

Vaucheria Schleicheri De Wild.—(a) End of a filament bearing an oogonium and four mature antheridia. (b) Mature antheridium showing inner diaphragm and formation of cellulose callus. (c) Slightly more mature antheridium (same as the one at extreme right in fig. a) showing the gelatinous plug at apex; inner diaphragm still present. Outer interrupted line marks pectic (?) layer. (d) Smallest measured antheridium

(empty); circle at base marks insertion point. (e) Largest measured antheridium (empty). (f) Detail of oogonium in fig. a, showing gelatinous plug. (g) Broken end of a filament showing the dual nature of the wall: outer wall slightly tinged with yellow, inner wall hyaline. (h) Stratified cellulose (?) thickenings inside a filament; lower end shows a definite constriction of the filament. (i) Five stages in the opening of the antheridium: 1) Plain cellulose membrane. 2) Thickening of the apex and formation of inner diaphragm and stratified cellulose callus. 3) Cellulose callus becoming a gelatinous plug; inner diaphragm still present. 4) Resorption of inner diaphragm, and completion of gelatinous plug. 5) Plug is gone, and antheridium emptied. (Figs. a, g, h, 200 μ scale; figs. b–f and i, 100 μ scale.)

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NEW FERNS FROM THE NORTHERN ANDES

By William R. Maxon

Recent large collections of tropical American ferns received at the United States National Herbarium for identification have included a good many that apparently are new. Several of these from the northern Andes are described herewith as a small contribution toward making known this exceedingly rich fern flora. The first three are illustrated at slightly less than natural size by portions of the type specimens.

Hypolepis **crassa** Maxon, sp. nov. Plate 4.—Rhizoma late repens, brunnescens, ca. 5 mm. diam., sulcatum. Folia solitaria, ca. 70 cm. longa, suberecta; stipites 30–35 cm. longi, 3–5 mm. diam., e basi fusca castanei, tenuiter muriculati, leviter villosuli, pilis tortuosis mox delapsis; laminae subdeltoideae, acuminatae, 40 cm. longae, basi ca. 22 cm. latae, 2-pinnato-pinnatifidae, rhachi stipiti simili, flexuosa; pinnae ca. 12-jugae, subobliquae, triangulares vel superiores triangulari-oblongae, acutae, mediae 8–9 cm. longae, basi 3–5 cm. latae, infimae maximae, suboppositae, petiolulatae (1.5 cm.), 12–15 cm. longae, basi 6–7 cm. latae; pinnulae ca. 9-jugae, majores plerumque late triangulari-oblongae, obtusae, 2.5–4.5 cm. longae, 1–3 cm. latae, basi pinnatisectae, sursum profunde pinnatifidae (segmentis ca. 6-jugis), ceterae omnino pinnatifidae, rhachibus minoribus subtus leviter sed persistente brunneo-villosulis, pilis paucis venas adeuntibus; segmenta coriacea, opaca, plerumque oblonga, crasse lobata, lobis vel dentibus perpaucis, brevibus, deltoideis, apice rotundatis, majoribus emarginatis; venae infra valde depressae, fertiles 1- vel interdum 2-furcatae; sori 1–3-jugi, magni (1.5 mm. diam.), submarginales, crenatura marginali magna, rigide recurva, omnino immutata, crasse eroso-dentata; sporangia annulo articulis ca. 17 formato cincta, sporis diplanatis, ellipsoidalibus, laevigatis, 30 μ longis, ca. 21 μ crassis.

Type in the U. S. National Herbarium, no. 1,859,521, collected in dense chaparral, northwest slopes of Cayambe, on headwaters of east fork of Río Desaguadero, Imbabura Province, Ecuador, at about 3,840 meters altitude, July 10, 1944, by Ira L. Wiggins (no. 10386).

The outstanding features of *Hypolepis crassa* are its harsh texture and its coarse dissection, in which respect it is not very closely approached by other members of the genus. The notched margins of the segments and the huge sori, with their equally large, deeply recurved, unaltered, opposed marginal crenatures, are so coarse even as to carry a brief suggestion of *Dicksonia*.

Only one other sheet of no. 10386 was collected, this (Dudley Herbarium, Stanford University) quite like the type specimen. In reply to an inquiry Dr. Wiggins writes: "I remember the site at which the specimens were collected. In fact the memory of that point is accompanied by an involuntary shiver, for we camped there overnight and nearly froze! It was on a little shoulder of a lateral moraine, with a thick carpet of sphagnum over much of the ground, with *Puya* growing along the margin of the shelf and the whole area soaked with water. The fern was growing in a dense thicket of *Clusia* and several shrubs and trees that were not in flower or fruit. The soil in which the fern grew was rich in humus, black and mucky. It was on a fairly steep slope just above the comparatively level spot on which we pitched our tents, and was protected from the sweeping winds by the ridge above it and the density of the thicket. The deep green, glossy fronds were very attractive and quite outstanding in contrast with some of the other ferns there."

ADIANTUM **elegantulum** Maxon, sp. nov. PLATE 5.—Subg. *Euadiantum*. Rhizoma epigaeum, breviter repens (1–2 cm.), 0.8 mm. diam., ubique dense paleaceum, paleis late imbricatis, e basi cordata lanceolatis, longissime attenuatis, 1.5–2.5 mm. longis, basi 0.2–0.4 mm. latis, cinnamomeis, lucidis, subintegris. Folia ca. 8, disticha, adscendentia, 10–21 cm. longa; stipites 4–8 cm. longi, tenues (0.2 mm. diam.), brunnei, lucidi, tenuiter et minute paleacei, paleis fere capillaceis, flexuosis; laminae lineares, 6–13 cm. longae, 1.3–2.3 cm. latae, basin versus vix angustatae, apice acuminato-caudatae, 1-pinnatae, rhachi notis omnibus stipiti simillima, paleis minutis persistentibus; pinnae 10–21-jugae, patentes, breviter petiolulatae, trapeziformi-oblongae, apice rotundae, majores 8–11 (12) mm. longae, 3–4 mm. latae, vel fertiles subfalcatae et basi dimidiata latiores (usque ad 6 mm.), marginibus nisi fertilibus argute dentatis; pinnae supra glabrae, subtus tenuiter villosae, pilis fulvis tenuibus laxis obliquis subflexuosis ca. 0.8 mm. longis; venulae tenues, obliquae, crebrae; sori plerumque 4 vel 5, e basi anteriore pinnarum fere apicem adeuntes (interdum quoque 1 vel 2 latere posteriore apicem versus enati), oblongi vel sublunati, 1–1.5

mm. longi, lobo marginali reflexo, amplo, dense setuloso, indusio vero angusto, minute lacero-fimbriato; sporangia annulo articulis ca. 17 formato cincta, sporis triplanatis, sublaevibus, ca. 33 μ diam.

Type in the U. S. National Herbarium, no. 1,774,736, collected in the region of Villavicencio, toward El Parrao, Intendencia El Meta, Colombia, altitude 500 meters, November 10, 1938, by J. Cuatrecasas (no. 4632).

Though the single specimen described is simply pinnate only, it is possible or even probable that further material will show the mature condition to be bipinnate, placing the species in the neighborhood of *A. terminatum* Kunze, notwithstanding its extreme delicacy. The stipes and rachises are as slender as those characterizing the tropical American species centering around *A. dolabriforme* Hook., a group to which *A. elegantulum* is, however, not at all closely related.

POLYPODIUM **militare** Maxon, sp. nov. PLATE 6.—Subg. *Eupolypodium*. Rhizoma repens, 2–3 cm. longum, ca. 1 mm. diam., copiose paleaceum, paleis ochraceo-brunneis, teneris, laxe imbricatis, lanceolatis, 2–3 mm. longis, basi rotunda vel subcordata 0.5–0.8 mm. latis, apice attenuatis, laxe ciliatis (ciliis ca. 2 mm. longis, ochroleucis), tenere clathratis, parietibus exterioribus pallidis, nitidis, transversalibus fuscis, ca. 9 μ crassis. Folia plura, non remota, rigide erecta, 10–18 cm. longa; stipites ca. 1 cm. longi, 0.5–0.7 mm. diam., plerumque arcuati, atrofusci, primum dense et minutissime puberuli, pilis rigidis, ochroleucis, ca. 0.2 mm. longis; laminae ligulatae, 9–17 cm. longae, 2–3.5 mm. latae, basin versus angustatae, oblique pinnatisectae, glaberrimae, rhachi atrofusca, infra valde elevata, supra plana; segmenta crasse coriacea, latere utroque 45–85, valde obliqua, ambitu inaequilateraliter deltoidea, basi 2–3 mm. lata, apice rotunda (siccitate plus minusve acutiuscula), decurrentia, valde concava (marginibus integris late revolutis), fertilia praesertim fere saccata; segmenta inferiora sensim reducta, venis simplicibus vel furcatis; venae pinnarum majorum pinnatim ramosae, venulis utrinque 1 vel 2, tenuibus, laxe et varie dispositis; sori mediocres, solitarii, venis ipsis subterminales, saepe basi venulae distalis aut anterioris aut posterioris siti; sporangia annulo articulis ca. 12 formato cincta, sporis triplanatis, papillosis, 35–44 μ diam.

Type in the U. S. National Herbarium, no. 1,857,352, collected from "rocks covered with moss and sand," Páramo de Sonsón, Department of Antioquia, Colombia, altitude 2,700–2,850 meters, January 29, 1945, by Brother Daniel (no. 3431).

The relationship of *Polypodium militare* is clearly with *P. humile* Mett., from the same region, of which there is at hand a specimen of the type collection (*Lindig* 137) received from Kew. The two are similar in their rhizome scales, size, and perfectly glabrous, rigidly coriaceous blades, but *P. humile* may be dis-

tinguished by its broader blades, less oblique segments, and more numerous sori, as many as five being crowded together within the short revolute segments, whereas *P. militare*, as shown by a large series of specimens, is invariably monosorous. The deeply cavernous segments are a remarkable feature.

POLYPODIUM **Buesii** Maxon, sp. nov.—Subg. *Eupolypodium*. Rhizoma adscendens vel breviter repens, 5–10 mm. longum, ca. 5 mm. diam., apice dense paleaceum, paleis pallide ochraceis, lineari-attenuatis, 3–4 mm. longis, 0.5–0.8 mm. latis, prope basin subcordatam affixis, varie denticulatis, tenuiter clathratis. Folia plura, fasciculata, 12–20 cm. longa; stipites 1–6 cm. longi, ca. 0.5 mm. diam., sordide ochracei, copiose pilosi, pilis rigidis, rubescentibus, usque ad 2.5 mm. longis; laminae ligulatae, 11–18 cm. longae, medio 8–10 mm. latae, utroque longe attenuatae, subpinnatisectae, latere utroque segmentis ala ca. 0.5 mm. lata conjunctis, 2–6-jugis infimis longe dilatatis, humilibus; segmenta majora (basalia et apicalia minuta exclusa) ca. 60-juga, patentia, anguste oblonga vel triangulari-oblonga, apice rotunda, 3–5 mm. longa, medio 1–1.5 mm. lata, basi dilatata saepe 2 mm. lata, integra, herbacea, ubique (praesertim supra) setosa, pilis plurimis 1.5–2 mm. longis; venae segmentorum sterilium majorum et fertilium omnium ca. 1 mm. supra basin furcatae, ramo basali brevi; sori in segmentis solitarii, magni (1.5 mm. diam.), rhachin partim incumbentes, ramo basali inframediales; sporangia numerosa, globosa, annulo articulis ca. 14 formato cincta, sporis triplanatis, globosis, papillosis, ca. 30 μ diam.

Type in the U. S. National Herbarium, no. 1,858,604, collected on Cerro Chuyapí, Department of Cuzco, Peru, at 2,400 meters altitude, June 24, 1941, by C. Bues (no. A45). There are at hand also another specimen (*Bues* A38) from the type locality and a single excellent plant with the following data: "Los Palmitos," Cabecera del Koribeni, Peru, altitude 3,000 meters, September 1932, *C. Bues* 1963. The three agree closely.

Because of its toothed rhizome scales, which are devoid of cilia, *Polypodium Buesii* belongs to the immediate group of *P. trichomanoides* Swartz, the most recent discussion of which[1] includes a revised key to the five species previously known, all but *P. trichomanoides* itself being wholly West Indian. It is perhaps nearest *P. trichomanoides*, figured and discussed at some length by the writer long ago,[2] though that species departs widely in its elongate fertile vein-branches and gibbous segments.

POLYPODIUM **oreophilum** Maxon, sp. nov.—Subg. *Eupolypodium*. Rhizoma repens, 2–4 cm. longum, parce ramosum, 2–3 mm. diam., ubique dense comoso-paleaceum, paleis numerosissimis, acervo incano-brunneis, deltoideo-linearibus, ca. 6 mm. longis, basi 0.5–0.7 mm. latis, longissime attenu-

[1] Amer. Fern Journ. 31: 105–111. *pl. 1.* 1941.
[2] Contr. U. S. Nat. Herb. 17: 550. *pl. 35.* 1916.

HYPOLEPIS CRASSA Maxon

Adiantum elegantulum Maxon

POLYPODIUM MILITARE Maxon

atis, subflexuosis, basi subcordata incrassata firme affixis, clathratis (parietibus exterioribus hyalinis, transversalibus brunneis, ca. 18 μ crassis), copiose ciliatis, ciliis incanis, rigidis, ca. 0.2 mm. longis. Folia multa, fasciculata, erecta, 25–30 cm. longa; stipites 2–5 cm. longi, aequaliter 0.7 mm. diam., brunnei, ubique minute et dense incano-hirtelli, pilis rectis, ca. 0.2 mm. longis; laminae lineares, ca. 25 cm. longae, medio 3–4 cm. latae, utrinque attenuatae, pinnatae, rhachi utrinque atrofusca, supra dense griseo-hirtella, infra fere glabra; pinnae 75–85-jugae, confertae (sinubus angustissimis), patentes vel leviter obliquae, lineares, majores 1.5–2.3 cm. longae, medio 2–3 mm. latae (basi leviter decurva 2.5–4 mm. latae), ultra medium modice angustatae, apice ipso rotundae, integrae, membranaceo-herbaceae, fere glabrae (subtus pilis glandulosis furcatis fuscis dissitis minutissimis instructae), costis tenuibus, fuscis, supra modice elevatis, infra subimmersis; venae 11–14-jugae, simplices, obliquae (40°), hydathodis subrotundis vel ellipticis margine remotis terminatae; sori apice venarum siti, rotundi, superficiales, ca. 1 mm. diam.; sporangia annulo articulis 12 formato cincta, sporis triplanatis globosis, papillosis, ca. 32 μ diam.

Type in the U. S. National Herbarium, no. 1,705,807, an epiphyte collected on Cerro Armas, Department of Santander, Colombia, altitude 1,200 to 1,500 meters, in forest, July 26, 1936, by Oscar Haught (no. 1959).

Of the species of comparable size having grayish-ciliate rhizome scales *Polypodium oreophilum* need be compared only with *P. Stuebelii* Hieron., of Colombia, and the well-known *P. apiculatum* Kunze, which is of wide distribution. From description and illustration *P. Stuebelii* differs in its consistently lesser dimensions (rhizome only 1 mm. thick, with small, few-ciliate scales), in its setulose segments, and its fewer and smaller sori. *Polypodium apiculatum* differs even more widely in its long stipes, and its abruptly apiculate-caudate blades, which are not attenuate at base and have the rachis conspicuously hirtellous beneath.

Polypodium **assurgens** Maxon, sp. nov.—Subg. *Eupolypodium*. Rhizoma elongatum, adscendens, usque ad 12 cm. longum, 3–5 mm. diam. (stipitibus exclusis), ubique arte imbricato-paleaceum, paleis lanceolatis, apice attenuatis, 4–5 mm. longis, prope basin cordatam 0.7–1.2 mm. latis, brunnescentibus, clathratis. Folia 6–12, erecta, 25–35 cm. longa, oblique contigua, basi late imbricata; stipites breves, 1–3 (5) cm. longi, 1 mm. diam., brunnescentes, nudi, glabrati; laminae anguste ligulatae, utrinque attenuatae, plerumque 25–30 cm. longae, 7–12 mm. latae, pinnatisectae, rhachi valida, fusca, supra plana, subtus tereti, primum minutissime puberula; segmenta coriacea, opaca, 50–70-juga, subquadrata vel rotundato-deltoidea, alterna, apicalia sensim minuta, infima alariformia, media (maxima) 3–6 mm. longa, basi 4–6 (7) mm. lata, leviter revoluta, sinubus anguste acutis; costae immersae; venae 3–4-jugae, simplices, sub angulo

45° egredientes, immersae; sori 2–3-jugi, mediales, rotundi, 1.5 mm. diam., segmentis partis superioris laminarum siti; sporangia annulo articulis ca. 12 formato cincta, sporis triplanatis, globosis, papillosis, 50–55 μ diam.

Type in the U. S. National Herbarium, no. 1,707,880, collected on the Quito-Santo Domingo road, Province of Pichincha, Ecuador, at 2,300 meters altitude, in a bed of moss, April 5, 1942, by Oscar Haught (no. 3226); several identical specimens of this number were obtained. An additional collection is from Peru: Cerro Chuyapí, Dept. Cuzco, alt. 2,500 meters, *Bues* A37.

The present species belongs to the group of *P. moniliforme* Lag. and is clearly allied to *P. Wolfii* Hieron.[1] That, however, is a much more delicate plant, and differs among other characters in having the rhizome only 1 mm. thick, stipes barely 0.5 mm. in diameter, costae of the segments dark, prominent, and terete beneath, and only a few of the segments (these basal) broadened at base and thus subdeltoid, a general condition in *P. assurgens*. In size and proportions, nevertheless, the two species are very much alike.

Lindsaea (?) **spathulata** Maxon, sp. nov.—Rhizoma breviter repens, ca. 5 mm. diam., apice dense comoso-paleaceum, paleis brunneis, rigidis, falcatis, subulato-capillaceis, 6–8 mm. longis, basi 0.3–0.4 mm. diam., turgidis, fibrosis. Folia plura, suberecta, contigua, ut videtur disticha, 65 cm. longa; stipites 20 cm. longi, ca. 1.5 mm. diam., e basi brunnea olivacei, nudi, glabri, nitentes, subquadrangulares; laminae anguste lanceolatae, apice attenuatae, 45 cm. longae, 10–13 cm. latae, 3-pinnato-pinnatifidae, rhachi subflexuosa, straminea, glabra; pinnae remotae, alternae, obliquae (45°), petiolulatae, majores utroque ca. 9, inaequilateraliter deltoideo-ovatae, usque ad 8.5 cm. longae et 4 cm. latae, acuminatae; pinnulae valde anadromae, majores utroque ca. 6, maximae basi pinnatae, divisionibus oblique subpinnatisectis, segmentis tenuiter chartaceis, paucis (3 vel 4), alternis, majoribus bilobatis vel bipartitis, ambitu cuneatis, usque ad 7 mm. longis, ceteris elliptico-spathulatis, 4–5 mm. longis et ca. 2 mm. latis, rhachibus ultimis anguste marginatis 0.5–1 mm. latis; venae segmentis vel lobis geminis solitariae, mediae; sori terminales, submarginales; indusia tenerrime membranacea, transverse oblonga vel subrotunda, 0.5–1 mm. lata, basi curvata affixa, marginem vix mutatam non attingentia; sporangia 2–4, sporis triplanatis.

Type in the U. S. National Herbarium, no. 1,705,808, collected on Cerro Armas, Department of Santander, Colombia, altitude 1,300 meters, July 26, 1936, by Oscar Haught (no. 1960).

Lindsaea (?) **Killipii** Maxon, sp. nov.—Rhizoma repens, 5 mm. diam., dense paleaceum, paleis imbricatis, brunneis, rigidis, subulato-attenuatis, 5–7 mm. longis, prope basin usque ad 0.8 mm. latis, integris, turgidis,

[1] **Hedwigia 48: 250. *pl. 12, figs. 17, 17a, 17b.* 1909.**

fibrosis. Folia plura, adscendentia, 90–95 cm. longa, ubique glabra; stipites ca. 45 cm. longi, ca. 1 mm. diam., subquadrangulares, brunnescentes, nudi, lucidi; laminae lanceolatae, apice subacutae, 45–50 cm. longae, medio 6–9 cm. latae, 3-pinnato-pinnatifidae, rhachi stipiti simili; pinnae paucae (utrinque ca. 8), inter se longe remotae, alternae, petiolulatae, obliquae, inaequilateraliter deltoideae vel late trapeziformi-ovatae, maximae 4–6 cm. longae, ca. 3 cm. latae, obtusae vel acutiusculae; pinnulae valde anadromae, majores utrinque ca. 3, maximae basi pinnatae, divisionibus obliquis, subpinnatisectis, segmentis 3 vel 4, herbaceis, linearibus, 3–5 mm. longis, 0.7–1 mm. latis, singulis vel paribus oblique conjunctis, rhachibus ultimis anguste marginatis latitudine aequalibus; venae solitariae, mediae; sori terminales, submarginales; indusia tenera, subrotunda, ca. 0.7 mm. lata, basi curvata affixa, marginem herbaceam oppositam non attingentia; sporangia perpauca, sporis triplanatis, laevigatis, ca. 50 μ diam.

Type in the U. S. National Herbarium, no. 1,144,644, collected at "La Gallera," Micay Valley, Department of Cauca, Colombia, altitude 2,000–2,200 meters, in forest, July 1, 1922, by E. P. Killip (no. 7947). Duplicates were distributed to the Gray Herbarium, the New York Botanical Garden, and the Academy of Natural Sciences of Philadelphia.

Among other characters this species is readily distinguished from the last by its linear segments (about 1 mm. broad), these contrasting strongly with the expanded segments of *L. spathulata*, which are 2 mm. broad below the tip; but the proper generic reference of these plants is a matter of doubt and must remain so, pending a critical review of the entire group, which Christensen (Manual of Pteridology, p. 535) calls the subfamily Lindsayoideae. He describes the creeping rhizome of *Lindsaya* [sic] as of a "special 'lindsayoid' type and clothed with bristles or narrow, lanceolate, castaneous scales consisting of 2–4 rows of cells, or both types with intermediate forms intermixed." In architecture the fronds of the two new species resemble *Sphenomeris clavata* (L.) Maxon and *S. chinensis* (L.) Maxon; but *Sphenomeris*[1] has diplanate spores and the truly marginal sori are endophyllous and urceolate, with both valves of the indusium similar in texture, the likeness being thus superficial so far as sori are concerned.

SMITHSONIAN INSTITUTION.

[1] The recent reduction of *Sphenomeris* to synonymy under *Stenoloma* Fée (Gen. Fil. 330. 1852) seems scarcely justifiable. Of the seven species which Fée figures under *Stenoloma* one is regarded by him as doubtful, and of the remaining six no less than four are plants of indefinite scandent growth, with more or less endophyllous sori and triplanate spores,—characters now recognized as distinguishing the genus *Odontosoria*. *Stenoloma* was thus preponderantly *Odontosoria*, a genus which Fée did not clearly differentiate. To typify it on *Adiantum clavatum*, which is of determinate growth, appears quite unwarranted. (See Journ. Washington Acad. Sci. 3: 143–144. 1913; Contr. U. S. Nat. Herb. 17: 157–168. *pls.* 2–5. 1913.)

POLYPODIUM LEPIDOPTERIS AND ITS RELATIVES IN BRAZIL

By C. A. Weatherby

Polypodium lepidopteris (L. & F.) Kze. and its immediate allies constitute one of those critical groups, too numerous in ferns, whose taxonomy has not been worked out in detail. As a group, it resembles that of *P. polypodioides* (L.) Watt in that it consists of a series of populations very similar in habit, but more or less disjunct geographically and differing in the characters of their paleaceous vestiture. Following Gustav Kunze, Mettenius and Hooker,[1] it has long been treated as a single, rather polymorphous species ranging over a good part of South America and extending into Mexico. Baker, in the Synopsis Filicum and the Flora Brasiliensis, began the breaking up of the complex, recognizing as varieties three perfectly valid segregates; unfortunately, he got wrong names for all three. Maxon, Contrib. U. S. Nat. Herb. xvii. 592–3 (1916), removed from the inclusive *P. lepidopteris* the Mexican elements and those of northwestern South America. Because of insufficient material, he made no attempt to deal with the Brazilian populations. Dutra, in 1940, briefly sketched the characters of the two south-Brazilian species and corrected Baker's errors in nomenclature. Now, after examination (in 1939) of the herbaria at London, Geneva and especially the rich collections at Paris, and of abundant specimens of one little-known species brought back by L. O. Williams in 1945 from Minas Geraes, an attempt further to fill out previous work seems justified. At least, lines of variation can be pointed out and some clarification of nomenclature made.

The group, as here understood, comprises six known species occupying two disjunct geographic areas. One of these is in northwestern South America and harbors two[2] species—*P. bombycinum* Maxon, of Colombia, Panama and the Galápagos Islands, apparently at altitudes of 300 m. or more, and *P. balaonense* Hieron., known, so far as specimens and records at hand show, only at very low altitudes along the coastal strip of Ecuador.[3] The other area extends from southern Bahia and

[1] Hooker, however, remarked "if, as I think, all the references brought together under this species are correct, it is hard to say what are the limits of species among ferns." Sp. Fil. iv. 211, 212 (1862).

[2] Perhaps more when recent collections are studied. The plant of the Galápagos may prove varietally separable from *P. bombycinum*.

[3] It is interesting to note that the species of higher altitudes, not that geographically nearest, crosses to the Galápagos.

Espiritu Santo, Brazil, south to Uruguay, Paraguay and the arm of Argentina which stretches between them. In this area I am recognizing four species.

The group as a whole is characterized as follows: rhizome short-repent, 3–5 mm. thick, densely covered with castaneous, concolorous, deltoid-ovate to deltoid-lanceolate scales with elongate, thin-walled cells (except near the point of attachment); fronds given off singly, but usually not more than 1 cm. apart; blades narrowly elliptic to linear, pinnate or deeply pinnatifid, narrowed gradually from the middle to apex and base, usually with several pairs of reduced lower pinnae; pinnae in well developed individuals numerous, up to 50 pairs, entire except for a small, rounded auricle at base on the upper side, which bears in its center a large, dark, immersed gland or aerophore; both surfaces more or less densely scaly; venation goniophlebioid; sori surrounded by a ring of modified scales; sporangia with long, very slender stipe and narrow ring of about 12 cells; spores biplanate, ellipsoid or subreniform, irregularly tuberculate and with nigrescent markings. In the Brazilian species, there is considerable intraspecific variation in habit and in size and abundance of scales; but the patterns of scale-form, on which the species mainly stand, are reasonably constant.

This study is based on material at Kew (K), Geneva (Gen), Paris (P), the United States National Herbarium (US) and the Gray Herbarium (G).[4] I am grateful to the officers of the institutions concerned for the privilege of examining the collections under their care and for many courtesies. I am particularly indebted to Dr. Ivan Klášterský of the National Museum at Praha for a photograph of and some scales from the type of *Polypodium rufulum* Presl, which have settled beyond doubt the application of that long misapplied name.

Key to the Group of Polypodium lepidopteris in Brazil

a. Scales of the lamina all of a deltoid-linear type, passing without abrupt contraction from a coarsely erose base to an evenly attenuate, more or less long-dentate blade ..... *P. minarum*

a. Scales of the leaf-surface of a gomphoid[5] type, i. e. with a finely erose-fimbriate orbicular base abruptly contracted into a subcapillary, entire or short-dentate upper portion ..... *b.*

[4] I am of course aware that Dr. Lanjouw has prepared a list of standard abbreviations for herbaria, in which Geneva appears as G and the Gray Herbarium as GH. Until, however, this very useful list has been generally accepted and formally approved by a botanical congress it seems better to keep the abbreviations hitherto used in these Contributions than to make the rather confusing shift of the "G".

[5] These scales in profile resemble a round-headed pin; I am therefore calling them gomphoid, pin-like.

b. Pinnae drying flat, the margin not cartilaginous.....*c*.
c. Scales of leaf-surface, rachis and costae all gomphoid and nearly alike, the capillary portion entire; ring of scales around sorus not conspicuous at maturity.....*P. monoides*
c. Scales of rachis and costae beneath deltoid-linear to deltoid-lanceolate, strongly pectinate-ciliate; capillary portion of scales of lower leaf-surface often short-dentate; ring of scales around sorus conspicuous..*P. hirsutissimum*
b. Pinnae undulate-crisped in drying, with a thick, pale, cartilaginous margin; scales of rachis and costae beneath deltoid-linear, sparsely pectinate-ciliate; capillary portion of scales entire; ring of scales around sorus not conspicuous.....*P. lepidopteris*

1. Polypodium **minarum,** sp. nov., characteribus gregis quibus addenda sunt sequentia. Rhizomatis paleae 4.5–6 mm. longae basi circa 1.25 mm. latae, basem versus serrulatae superne eroso-ciliatae (ciliis vel dentibus vix ultra 0.1 mm. longis e basi lato gradatim angustatis) e cellulis, eis baseos subquadratis exceptis, perangustis elongatis parietibus tenuibus luminisque concoloribus compositae. Stipes 3–8 cm. longus, dense decidueque paleaceus, paleis eis racheos similibus. Lamina 15–45 cm. longa, apice pinnatifida vel in lobum conforme desinens. Pinnae subdistantes vel approximatae, oblongae, plerumque 1–2 cm. longae 4 mm. latae, obtusae vel acutiusculae. Paleae paginae inferioris laminae deltoideo-lineares, circa 4 mm. longae, longe et basem versus dense ciliatae, pallide vel rarius saturate brunneae, ciliis 0.2–0.25 mm. longis; paleae racheos infra eis rhizomatis similes minores autem et longe denseque pectinato-ciliatae; paleae paginae superioris laminae albescentes e basi profunde lacerato peltato in partem superiorem angustissimam sparse longeque dentato-ciliatam subgradatim angustatae.

Type: Brazil, Minas Geraes, Serra da Piedade, 1843, *Claussen* 78 (P).

Other specimens examined. Brazil. Minas Geraes: Serra da Piedade, *Damazio* (P), *Gomes* 1081, 2004 (P); Ouro Preto, 1908, *Joaquim Candido da Costa Serra* (P); Serra do Frio, *Vauthier* 2335 (P); Serra do Curral, Municipio Nova Lima, alt. 1300 m., March 30, 1945, *L. O. Williams & V. Assis* 6397 (G); among shrubs on soil, vicinity of Lagoa Seca, 20 km. south of Belo Horizonte, Feb., 1945, *Williams* 5452 (G); epiphyte in forest, Serra de Mutuca, Nova Lima, Feb., 1945, *Williams* 5088 (G); without definite locality, *St. Hilaire* 1103, 2249 bis (P), *Riedel* 172 (Gen, P). Bahia: 14 so. lat. alt. 700 m., Dec., 1888, *E. Gonnelle* (P).

P. minarum varies more in habit than any other of the Brazilian species, from a linear frond less than 2 cm. wide and with close-set pinnae to one 4 cm. wide with the pinnae up to 1 cm. apart. The scales also vary considerably, but remain of the same general type.

2. Polypodium **monoides,** sp. nov., characteribus gregis, habitu P. *hirsutissimo*, paleis rhizomatis *P. minarum* similis, a speciebus affinibus omnibus differt lamina omnino paleis gomphoideis basi brunneo-punctatis

circa 0.4 mm. diametro, parte filiformi ad 3 mm. longa integra albescente (ad paginam superiorem) vel pallide brunnea (ad paginam inferiorem) vel (ad rachem) castanea plus minusve dense onusta.

TYPE: BRAZIL, BAHIA, forests of the Rio Grungogy Basin, alt. 100–300 m. Oct. 1–Nov. 30, 1915, *H. M. Curran* 274 (G); isotype, US.

Known only from the type collection, but, unless future collecting turns up intermediates now unknown, sharply distinguished from all other species of this group by its entirely uniform scale-pattern. If phylogenetic speculation is admissible in a small group of closely related variants, it might be guessed that this uniformity and the hair-like slenderness of the scales indicate that this is the most primitive species of the group.

3. POLYPODIUM LEPIDOPTERIS (Langsdorf & Fisch.) Kze. in Linnaea, xiii. 132 (1836), syn. plur. excl.; Dutra in Anais Prim. Reun. Sul-Amer. Bot. ii. 53 (1940).

Acrostichum lepidopteris Langsd. & Fisch. Ic. Fil. 5, t. 2 (1810). TYPE presumably at Leningrad; not seen, identity clear from Langsdorf & Fischer's plate.

P. sepultum Kaulf. Enum. 104 (1824). Essentially a renaming of *A. lepidopteris*, which is cited as an unequivocal synonym; Kaulfuss' description also applies to it.

Goniophlebium lepidopteris (L. & F.) Moore, Ind. Fil. lxxiv (1857); Fée, Crypt. Vasc. Brésil, 108 (1869).

P. crassimargo Kze. ex Mett. Polypod. 71 (1857), nomen nudum.

G. crassimargo (Kze.) Moore, Ind. Fil. 388 (1862).

P. lepidopteris, var. *rufulum* (Presl) Baker in Mart. Fl. Bras. i, pt. 2: 527 (1870), quoad plantam descriptam, non *P. rufulum* Presl.

Lepicystis lepidopteris (L. & F.) J. Sm. Hist. Fil. 112 (1875).

P. rufulum, forma *intermedium* Hassl. Trab. Inst. Bot. Farm. Buenos Aires, no. 45: 73 (1928). Type not designated; *Hassler* 3991 in herb. Bonaparte, Paris, taken as determining identity.

P. rufulum "formas" *majus* and *minus* Osten & Herter in Anal. Mus. Hist. Nat. Montevideo, ser. 2, i. 368 (1925); repr. "Plantae Uruguayenses," 44. No specimens cited; the forms distinguished by size only.

Rhizome-scales in mass tending to a dark, almost purplish brown. Stipe variable both in absolute and relative length, from 1/10 to 1/3 as long as the lamina, deciduously scaly. Lamina 19–46 cm. long, 1.7–6 cm. wide, at least ten times as long as broad, gradually to subabruptly narrowed at base, with up to 8 pairs of reduced pinnae (sometimes no auriculiform ones), attenuate above to a pinnatifid apex or a conform terminal lobe. Pinnae usually oblong, 0.8–3.7 cm. long, 4–9 mm. wide (⅓ to ½ as wide as long), obtuse, or in the wider blades, acute. Scales of the lower surface of the lamina pale brown in mass, 3–5 mm. long, 0.1–0.15 mm. wide, their long tips giving a characteristic shaggy appearance to the frond.

Representative specimens. Brazil. Espirito Santo: *St. Hilaire* 307 (P). Rio de Janeiro: Itaypu, dans les sables, *Glaziou* 1221, 5652 (P). Santa Catharina: *St. Hilaire* 1751 (P); *Schwacke* 12888 (P); auf Sandboden . . . in der Nahe des Meeres, Itajahy, *Ule* 175 (P). Rio Grande do Sul: ad terram arenosam, Hamburger Berg, *Lindman* A505 (G, Gen, US); ad rupes, Porto Alegre, *Stier* in Rosenstock, Fil. Austrobras. 317 (P, US), *Fox* 109 (K).

Paraguay: Cerro de Tobati, *Fiebrig* 751 (BM, G, Gen, K, P, US); sur les rochers, Paraguari, *Balansa* (K, P); Tobati, *Hassler* 3991 (G, P), 6182 (G, Gen).

Uruguay: entre les rochers, Maldonado, *Gibert* 621 (K, P, US); in montibus, Cerro de San Miguel, *St. Hilaire* 2035 bis (P); Catalan, *Herter* 995 (G, US).

4. Polypodium hirsutissimum Raddi, Opusc. Sci. Bologna, iii. 286 (1819) and Pl. Bras. i. 17, t. 26 (1825); Dutra in Anais Prim. Reun. Sul-Amer. Bot. ii. 53 (1940). Type presumably at Florence; not seen. Isotypes, BM, Gen, K, P.

P. rufulum Presl, Del. Prag. i. 164 (1822). Type at Praha; photo and fragm. G.

P. tricholepis Schrad. Götting. Gel. Anzeig. ii. 867 (1824). Type presumably at Göttingen, not seen. The species, proposed as distinct from *P. lepidopteris*, probably belongs here.

P. Raddii Desv. in Mém. Soc. Linn. Paris, vi. 232 (1827). A direct, and therefore illegitimate, renaming of *P. hirsutissimum*.

Marginaria rufula Presl, Tent. Pterid. 189 (1836).

Goniophlebium hirsutissimum (Raddi) Brack. Wilkes Exped. xvi. 33 (1854), excl. syn.; Fée, Crypt. Vasc. Brésil, 108 (1869).

P. lepidopteris sensu Baker, Syn. Fil. 346 (1868), Fl. Bras. i, pt. 2: 527 (1870), et auctt. plur., non (L. & F.) Kze.

P. vexillare Christ in Schwacke, Pl. Nov. Mineiras, ii. 21 (1900) et Bull. Herb. Boiss. ser. 2, ii. 373 (1902). Type not designated, and no specimen labelled by Christ found in his herb. at Paris. The specimen at Paris of the Ule collection cited by Christ is taken as authentic.

Goniophlebium hirsutissimum, var. *angustius* Fée, Crypt. Vasc. Brésil, 108 (1869), probably. No specimens cited and none so labelled seen.

Scales of the rhizome red-brown in mass, 5–7 mm. long, c. 1 mm. wide. Stipe 2–11 cm. long, 1 4 to 1/9 as long as the lamina. Lamina up to 75 cm. long, with 3–12 pairs of reduced basal pinnae, at apex somewhat less gradually narrowed, usually to a conform terminal lobe. Pinnae mostly linear-oblong, 2–3 cm. long, 5–6 mm. wide, rather abruptly acute, sometimes longer (but little wider) and acuminate, rarely obtuse. Scales 2–3 mm. long, those of the lower surface red-brown or pale brown in mass, their relatively large bases concealing the leaf-tissue, those of the upper surface whitish or pale brown, with small bases which do not come together and conceal the leaf-tissue.

Representative specimens. Brazil. Minas Geraes: Caldas, *Lindberg* 584 (K), *Regnell* I 469 (G, US); Serra do Frio, *Vauthier* 590 (G). Rio de Janeiro: *Wilkes Exped.* 5 (G, K, P, US); on ledge, Paineiras to Corcovado summit, 465–710 m., *L. B. Smith* 1252 (G). São Paulo: *Burchell* 196, 761, 3926, 4795 (K). Paraná: ad arborum truncos, Villa Nova près Rio Negro, *Annies* in Rosenst. Fil. Austrobras. 111 (P, US); ad arbores, Serra do Mar, Porto de Cima, 200 m., *Dusén* 713a (G); on rocks and trees, Tibagy, *Reiss* 1 (G). Santa Catharina: *Haerchen* in Rosenst. Fil. Austrobras. 111.1 (P, US). Rio Grande do Sul: in silva riparia, Porto Alegre, *Malme* 1328 (US); rupestre, São Leopoldo, *Eugenio Leite* 1942 (G); Neu Hamburg, *Bornmueller* 308 (G).

Paraguay: *Balansa* 329 (Gen); Alto Paraná, *Fiebrig* 5452 (G, US); Caaguazú, *Hassler* 8987 (G).

Uruguay: epiphyte on *Salix Humboldtiana*, Rio Negro, Cerro Largo, *Rosengurtt* PE4728 (G).

Argentina. Misiones: epifito en el monte vergen, Yerbal Viejo, *Burkart* 1583 (G); sobre les arboles, Loreto, *Perez-Moreau* 31/2063 (G).

According to Parlatore, Coll. Bot. Mus. Florence, 6 (1874), Raddi's herbarium, when it arrived at Florence, was wholly without labels; Parlatore himself named the specimens from Raddi's published works. This would diminish one's confidence in the authenticity of the isotypes of *P. hirsutissimum*, were it not that Raddi's description is so good as to leave little chance of error.

Dutra, supported by no less a pteridologist than Carl Christensen, states, as characteristic of *P. hirsutissimum*, that the sorus is somewhat immersed and surrounded by a membranous outgrowth of the epidermis, which forms a cup about it. My own dissections of boiled-out herbarium material show nothing with the undulate-walled cells ordinarily characteristic of epidermal tissue—only the scales of the lower surface, with straight-walled cells. These scales, in *P. hirsutissimum*, have larger basal discs than in other species of the group. In the vicinity of the sori their bases become larger yet and nearly or quite lose their acicular tips. The resulting orbicular or deltoid, crowded, more or less imbricated scales cover the sori when young, and, pushed up and outward against neighboring scales by the growing sporangia, remain as it were upright in a conspicuous ring around the sorus, even at full maturity. When the sporangia are dissected out what appears to be a considerable cavity is left; but when the scales also are removed, this is found to be only a shallow depression in the leaf-tissue, dotted with scars left by the scales.

The same is true of the other Brazilian species. In none of them is the ring of scales as conspicuous as in *P. hirsutissimum*, but in all it is present, the sori are in very similar shallow depressions, and they may or may not produce, at least in dried material, low bosses on the upper surface. One curious circumstance is that the receptacle is apparently separated from the vein-end by an abscission layer and the sorus can often be removed entire.

Polypodium lanosum Fée, Gen. Fil. 237 (1850–52), has often been cited as a synonym of *P. lepidopteris* sens. lat. I have seen no specimens of it. Fée's type was supposed to have come from Chile, where no species of the present group is known, and he takes no account of it in the Crypt. Vasc. Brésil. Until authentic material is found, the application of the name must remain doubtful.

Gray Herbarium.

SOME NEW SPECIES OF UTRICULARIA

By F. E. Lloyd and G. Taylor

Lately, one of us has published a detailed account of the biology of the genus *Utricularia* with special reference to the structure and mechanism of the traps (F. E. Lloyd, The Carnivorous Plants: Chaps. XIII & XIV, 1942). In this work, and also in some preliminary papers, names and figures have appeared of species which have not been validly described. The main purpose of this paper is to legitimize the names which have been published and diagnose other species.

Systematists have given scant attention to the traps (usually, but less happily, termed bladders) which are so characteristic of the genus and it is clear from the inadequate descriptions—usually limited to meagre particulars of size and shape—that the structure of these organs has been considered of minor taxonomic importance. Approximately 275 species are recognized in the genus and of these about 100 have been examined with particular attention to the trap structure. So far as material has allowed, this survey has shown that these organs provide important criteria for determining specific relationships and that comparisons based on trap morphology are no less effective than those depending on floristic or other details.

Material available for study is, more frequently than otherwise, badly preserved and commonly incomplete. The remark,

frequently recurring in literature, that leaves are absent during anthesis is probably never true but rather the product of observations on defective specimens. In collecting it is essential to secure full suites of specimens in which all parts of the plant are fully represented. The free-floating species give no difficulty apart from the care needed to display them properly on removal from the water. It is in the so-called terrestrial species and those attached to and ramifying in a submerged substratum that particular care is required to ensure complete representation. Wherever possible, in addition to dried specimens, some material should be preserved in fluid. Full notes should be made of the colour, habit and spatial relation to environment. The patience necessary to secure adequate specimens is amply repaid by the results derived from their examination.

Utricularia paradoxa Lloyd & Tayl. [apud F. E. Lloyd in Vict. Nat. liii. 93, 110 (1936), 164 (1937); The Carnivorous Plants, 225, t. 21, figs. 22, 23 (1942), *nom. nud.*], sp. nov., habitu *U. bilobae* R. Br. et *U. resupinatae* B. D. Greene valde similis sed statura minore; a priori differt foliorum segmentis setiferis (setis brevibus rigidisque); utriculos solum in stolonis gerentibus; a secunda differt foliis 3-fidis (segmentis filiformibus 1- vel nonnunquam 2-fidis).

A small delicate submerged plant with colourless stolons (ramifying in a loose substratum of mud or sand) from which, at intervals, arise vertical branches which emerge into the water above. Stolons with a sparse covering of unicellular oblique bristles along the upper surface, circinnate backwards at the apex. Vertical branches of limited growth, up to 5 cm. in length, occasionally bearing traps (or branches with traps), the lower "terrestrial" portion sparsely hispidulate with spreading bristles; emergent portion (usually about 3 cm. in length) green and bearing clusters of trifid leaves with the filiform segments 1–2-divided and towards the apex minutely hispidulate. Trap structure resembling that of *U. vulgaris* L.; traps up to 1.5 mm. in length but generally smaller, restricted to the substratum and borne on branches arising from the main stolon or from the base of vertical branches; antennae 2, up to 1 mm. in length, curving towards the entrance of the trap and bearing a few short bristles; trichomes 1–3, arising from the margin of the entrance between the antennae; internal bifid and quadrifid hairs with short ovoid arms of which (in the quadrifids) two arms are reflexed. Scape 1–4-flowered, up to 20 cm. in length, towards the base (in the substratum) bearing rhizoids with simple glandular hairs, relatively stout and sometimes sinuous, with a few basifixed scales throughout its length, towards the apex bearing paired bracts which subtend the showy flowers. Sepals membranous, each about 5 mm. in length, posterior ovate-acuminate, anterior narrower and less acuminate. Corolla segments violet-blue; upper lip broadly elliptic, about 7 mm. long and 5 mm. broad, entire at the apex; lower lip spreading, slightly gibbous,

Fig. 1A

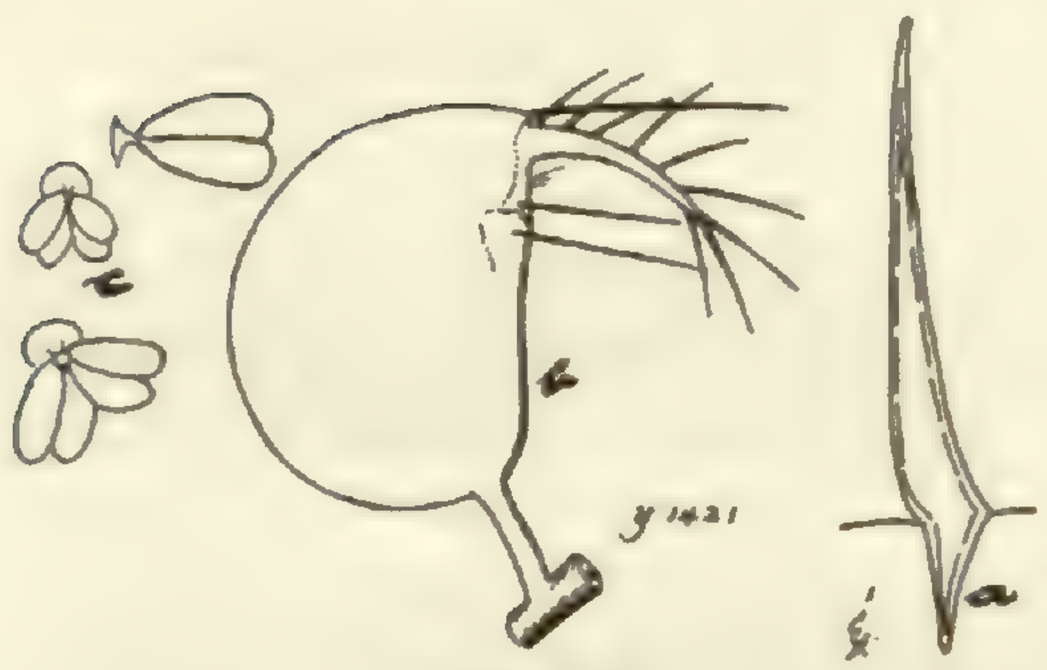


Fig. 1B

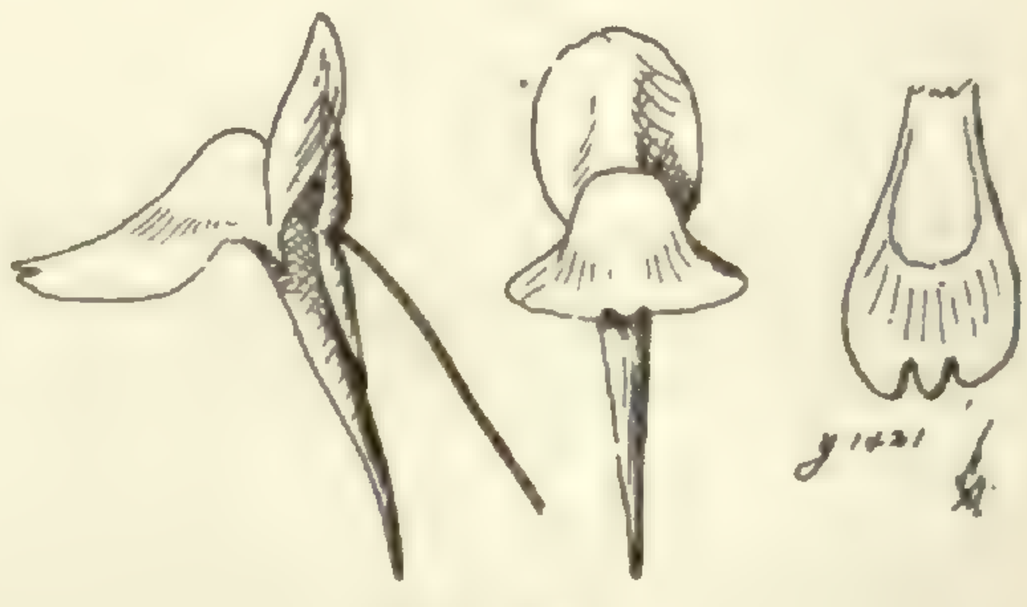


Fig. 1C

about 1 cm. long and 0.8 cm. broad, spathulate in outline, notched at the apex to form a small central and two shallow lateral lobes; spur about 1 cm. long, yellow, straight or slightly curved, tapering to a sharp point and directed downwards. Capsule ellipsoid, 3 mm. long and 1–5 mm. broad. Seeds somewhat angular, compressed; testa deeply reticulate.

Hab. ANGOLA: River Luena, Vila Luzo, 6 Nov. 1932. *R. G. N. Young* 1421 (*type* in Herb. Brit. Mus.). [Figs. 1A, 1B, 1C.]

In its remarkable habit, *U. paradoxa* resembles *U. biloba* R. Br., a native of Australia, and *U. resupinata* B. D. Greene, a native of North America. Except for the emergent flowers, these species are completely submerged with their main stolons buried in the substratum of mud or sand and their leafy branches projecting upwards into the water. Their traps, which are of the *U. vulgaris* type, remain embedded in the substratum.

U. paradoxa is apparently more closely allied to *U. biloba* but it is a much smaller and more delicate plant; it differs also in having the leaf segments hispidulate towards the apex and in the traps being confined to the branches in the substratum—in *U. biloba* traps are borne sparingly on the leaves. Leaf characters serve easily to distinguish *U. paradoxa* and *U. resupinata*. In the former the leaves are finely divided in precisely the same manner as those of *U. vulgaris*, whereas in *U. resupinata* they are simple and acicular. The rhizoids of *U. paradoxa* are simply branched but those of *U. resupinata* are usually once or twice divided.

The four species now to be described are very small inconspicuous plants, easily overlooked when not in flower. They appear to be most closely related to the S. American *U. peltata* Spruce with which they share a similar habit and the possession of peltate orbicular leaves.

Utricularia hydrocotyloides Lloyd & Tayl., sp. nov., affinis *U. exili* Oliv. et *U. Welwitschii* Oliv. sed ab utraque foliis peltatis corollaque longius calcarata differt; similis etiam *U. peltatae* Spruce ex Oliv., speciei austro-americanae purpureiflorae, sed ab hac foliis minoribus palatoque obscure tuberculato distinguitur. *U.* sp. aff. *peltata* F. E. Lloyd, The Carnivorous Plants, t. 29, figs. 9, 10 (1942).

A minute terrestrial plant with delicate filiform branched stolons. Leaves peltate, arising sparingly from the stolons; petiole 1–2 mm. long, filiform at the extreme base but relatively stout above, bearing secondary stolons towards the base of the thickened portion; lamina orbicular, 2–3 mm. broad, entire at the margin, glandular and strongly mucilaginous on the upper surface, stomata on the lower surface. Traps of the *U. capensis* type, borne on the stolons, appearing in dried material as 2-lipped with the lips fringed (as in *U. capensis*) with glandular trichomes each with a cylindrical apical cell and a stout conical basal cell; door with globose sessile trichomes but apparently lacking the kriss trichome; mouth of the trap opposite the stalk. Scape 1–2-(rarely 3-) flowered, almost capillary, 5–15 cm. in length, glandular-pubescent below, glabrous towards the apex. Bracteoles 2, appressed to the scape at a point below their middle, strongly glandular. Sepals 2, subequal, broadly ovate, upper acute at the apex, lower rounded at the apex, glandular outside, 2 mm. long and 1.5 mm. broad. Corolla white or sometimes faintly tinged purple in the throat, about 6 mm. long; upper lip triangular-concave, prolonged at the apex into a stiff spathulate appendage which projects above the palate of the lower lip, about 2.5 mm. long and about 2 mm. broad; lower lip semi-casqueform, obscurely tuberculate on the palate, broadly rounded at the apex, about 3 mm. long and 3 mm. broad, spur conical, gradually tapering to the apex which projects beyond the lower lip, about 3.5 mm. long.

Young 1155

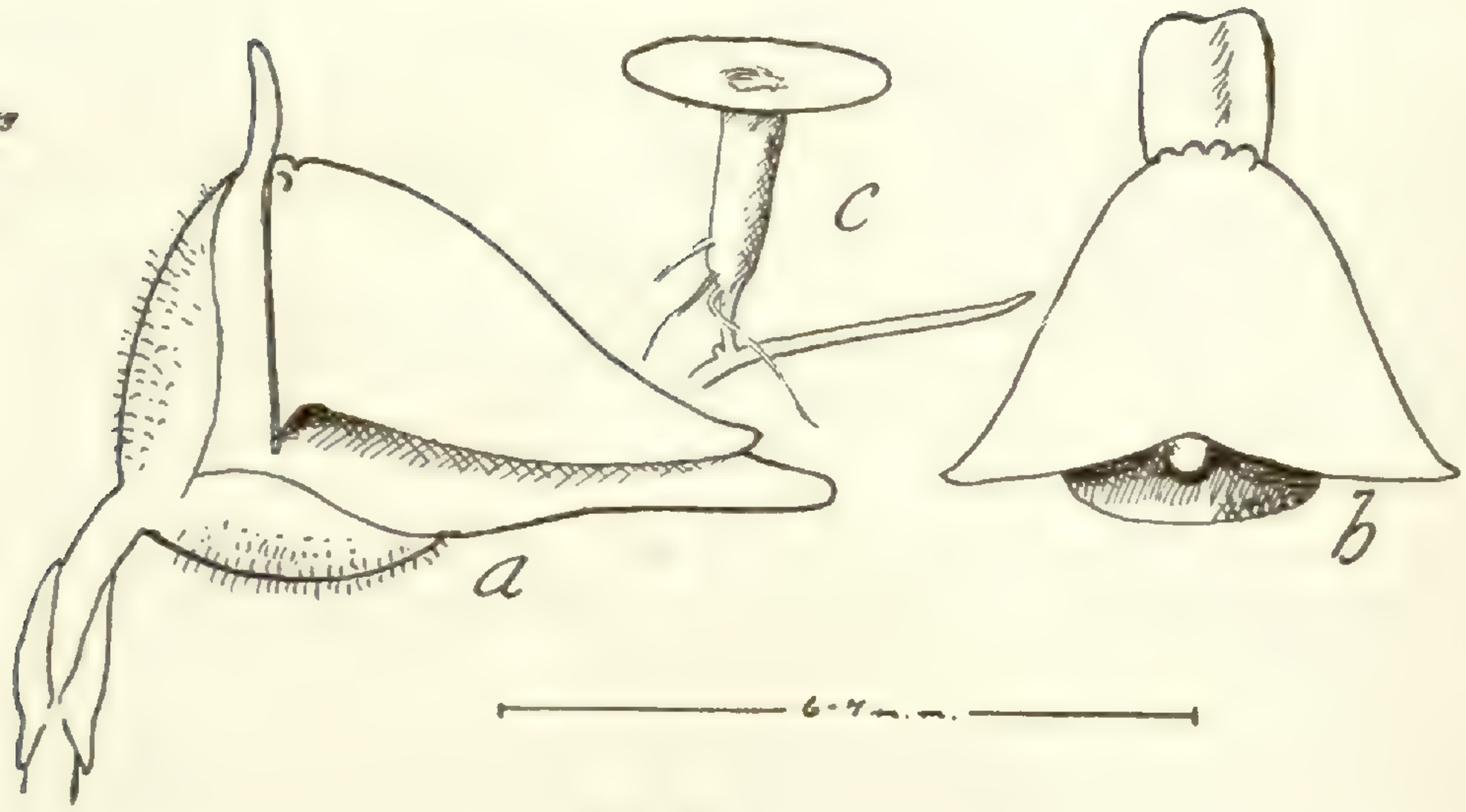


Fig. 2A

Young 1155

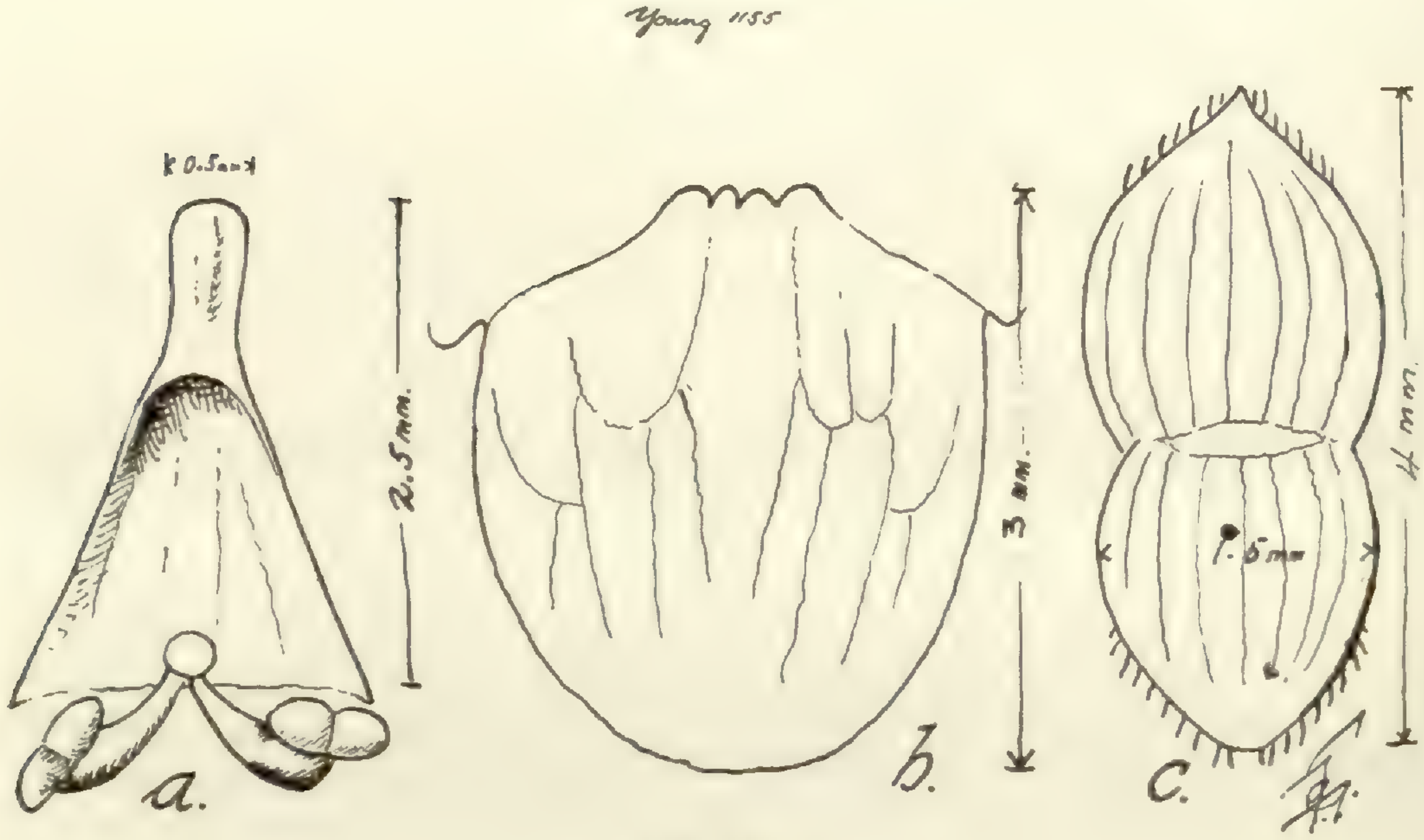


Fig. 2B

Hab. ANGOLA: Saurimo, flowers white, 24 Oct. 1932. *R. G. N. Young* 1155 (*type* in Herb. Brit. Mus.); River Luena, Vila Luzo, flowers small, white, 5 Nov. 1932. *R. G. N. Young* 1357 (Herb. Brit. Mus.). [Figs. 2A and 2B.]

. *U. hydrocotyloides* is allied to the African species *U. exilis* Oliv. and *U. Welwitschii* Oliv. but differs from both in having peltate leaves and a longer spur to the flower. It also resembles the purple-flowered *U. peltata* Spruce ex Oliv., a native of South America, but in having smaller leaves and obscurely tuberculate palate it can easily be distinguished from that species.

Utricularia Fernaldiana Lloyd & Tayl., sp. nov., arcte affinis *U. hydrocotyloidi* Lloyd & Tayl. sed differt sepalo postico apice truncato, corollae calcare multo longiore et tenuiore, palato apice bituberculato faucium lateribus corrugato.

Subterrestrial herb with delicate branched stolons, bearing rhizoids and secondary stolons at the nodes. Leaves peltate; petioles obconic, about 3 mm. long; lamina orbicular, about 3 mm. in diameter, mucilaginous on the upper surface. Traps of the *U. capensis* type, arising on the secondary stolons. Scape up to 6 cm. in length. Bracts affixed a little above their base, glandular-hispidulous. Flowers 1–2. Upper sepal broadly elliptic, truncate and crenulate at the apex, glandular-pubescent on the outside above the middle; lower sepal sub-orbicular, glandular-pubescent on the outside. Corolla rosy mauve; upper lip about 3.5 mm.

Tyler 1336

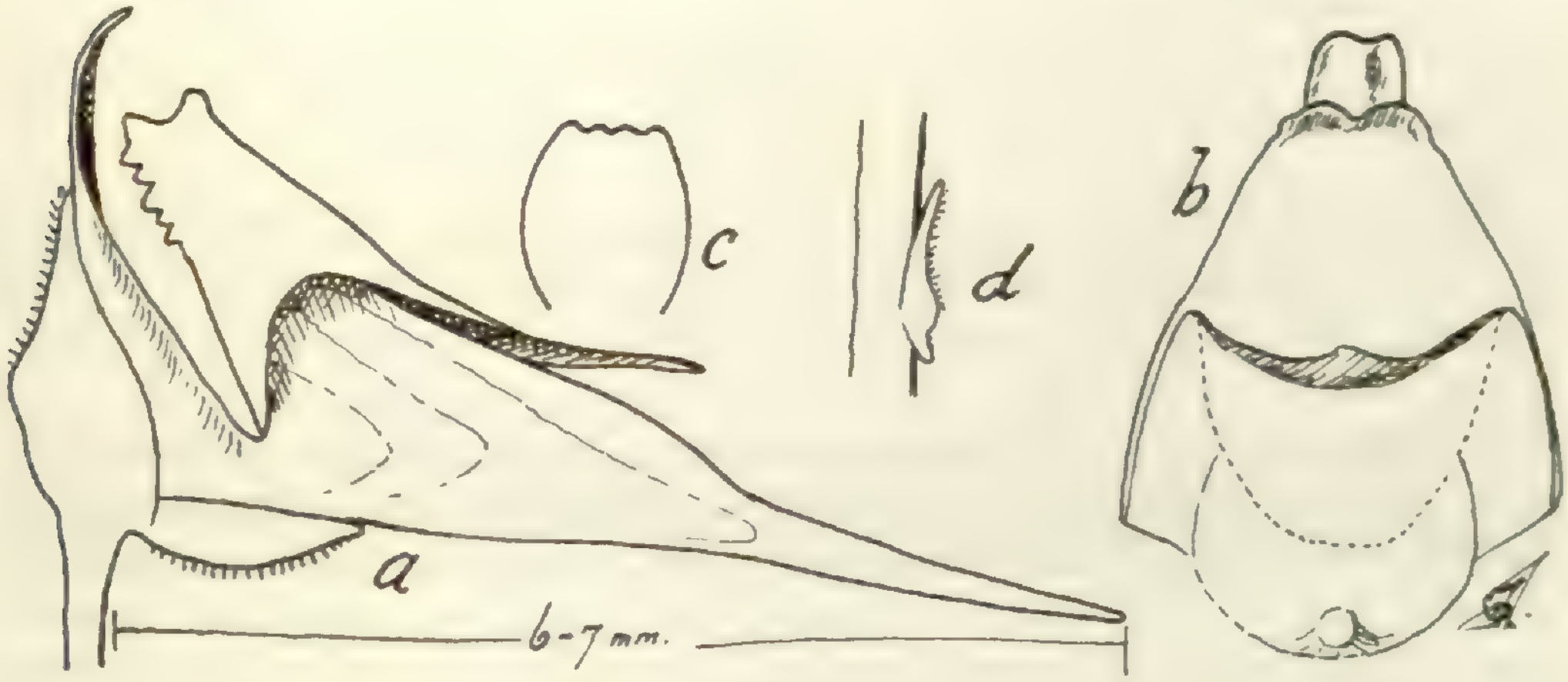


Fig. 3A

Tyler 1335

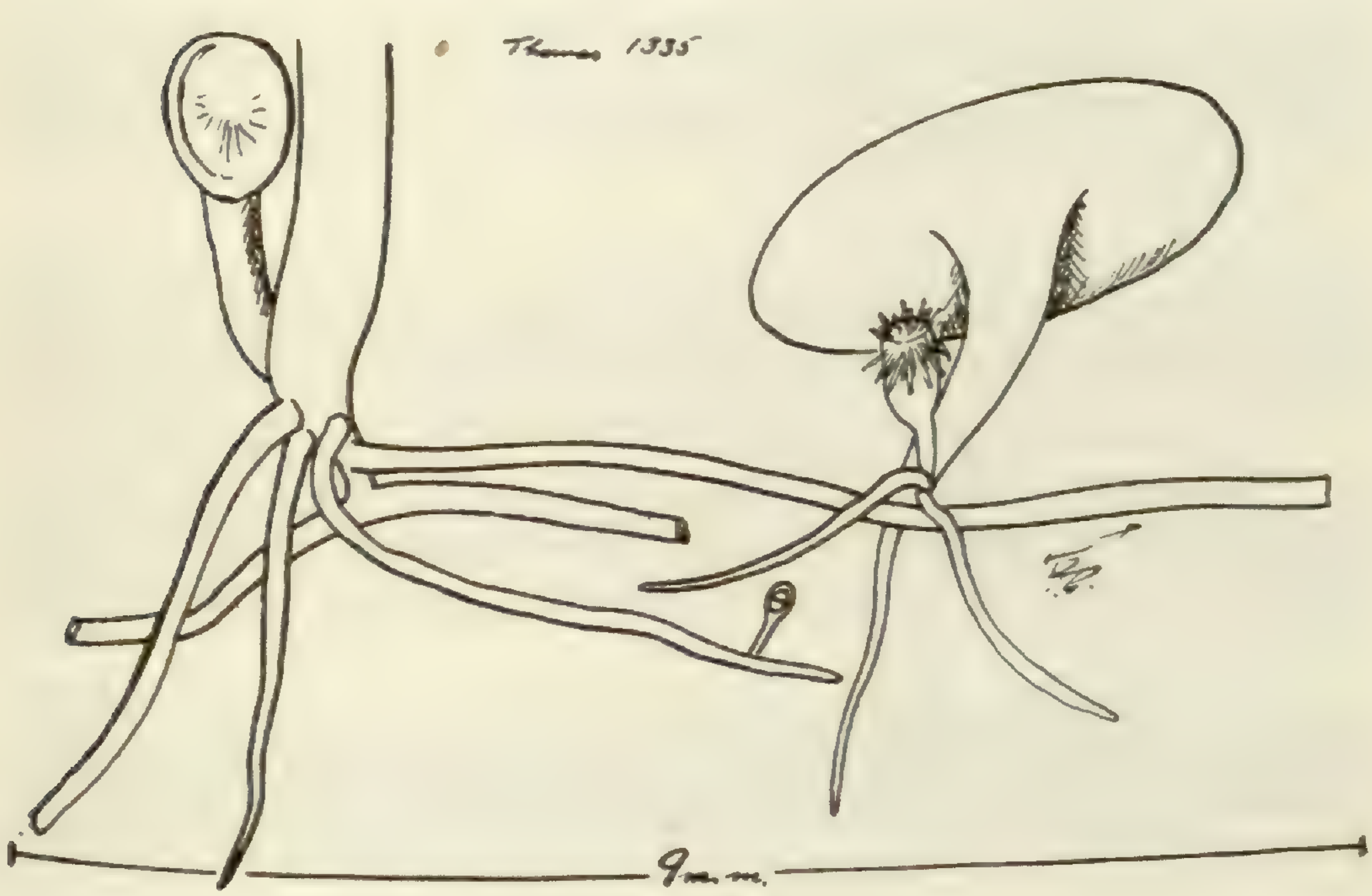


Fig. 3B

in length, concave-triangular, the apex prolonged into a quadrangular appendage exceeding and slightly over-arching the palate on the lower lip; lower lip more or less truncate-conical (the blunt top of the cone forming the 2-tuberculate palate which bears prominent corrugations in the throat towards the top), rounded at the apex; spur narrowly conical, 6–7 mm. in length, 1.5–2.0 mm. broad at the base.

Hab. UGANDA: Masaka Distr. Nabugabo, "short stems, leaves round, flowers with long spur, rosy mauve". Peaty swamp, 26 June 1935. *A. S. Thomas* 1335 (*type* in Herb. Brit. Mus.). [Figs. 3A and 3B.]

This species is closely related to *U. hydrocotyloides* but differs in having the upper sepal truncate at the apex, the spur much longer and more slender, the palate 2-tuberculate at the apex and corrugated at the sides in the throat.

Utricularia Thomasii Lloyd & Tayl., sp. nov., proxime affinis *U. hydrocotyloidi* Lloyd & Tayl. sed ab utraque sepalo postico apice rotundato, corollae calcare labium inferius aequantivel vix excedenti, palato etuberculato.

Subterrestrial herb. Stolons and bladders as in *U. Fernaldiana.* Leaves orbicular-umbiculate; petiole slender, very gradually expanding upwards into the lamina, up to 10 mm. long, bearing one or more rhizoids; lamina 2.5 mm. in diameter. Scape 1–2-flowered, capillary, up to 4.5 cm. long. Bracts affixed a little above their base, glandular-hispidulous on the outside. Upper sepal ovate, shortly apiculate at the apex, glandular-pubescent on the outside; lower sepal ovate, rounded at the apex, glandular-pubescent on the outside. Corolla white flushed rose-pink, about 2 mm. in length; spur short, about 0.5 mm. long, blunt and rounded at the apex, not or scarcely exceeding the lower lip and the lower sepal. Capsule ovoid, 2 mm. long and 1.5 mm. broad. Seeds (immature) somewhat pyramidal.

Hab. UGANDA: Masaka Distr. Nabugabo, alt. 3900 ft., local. "leaves round; flowers small, white flushed rose-pink, peaty swamp", 26 June 1935. *A. S. Thomas* 1334 (*type* in Herb. Brit. Mus.). [Fig. 4.]

A collection from the Bukoba District made by Haarer (alt. 400 ft., Jan. 1932. *Haarer* 2439 (Herb. Kew.)) may belong to this species but in the absence of leaves a definite identification cannot be given.

U. Thomasii is closely related to *U. hydrocotyloides* and *U. Fernaldiana* but differs from both in having the spur of the corolla only equalling or scarcely exceeding the lower lip, the upper sepal rounded at the apex and the lower lip of the corolla (palate) not tuberculate.

The species also closely resembles *U. tribracteata* Hochst. in its floral construction but differs from that plant in the absence of rugosities on the lower lip. The possession of peltate leaves, of course, serves to distinguish *U. Thomasii.*

Thomas 1334

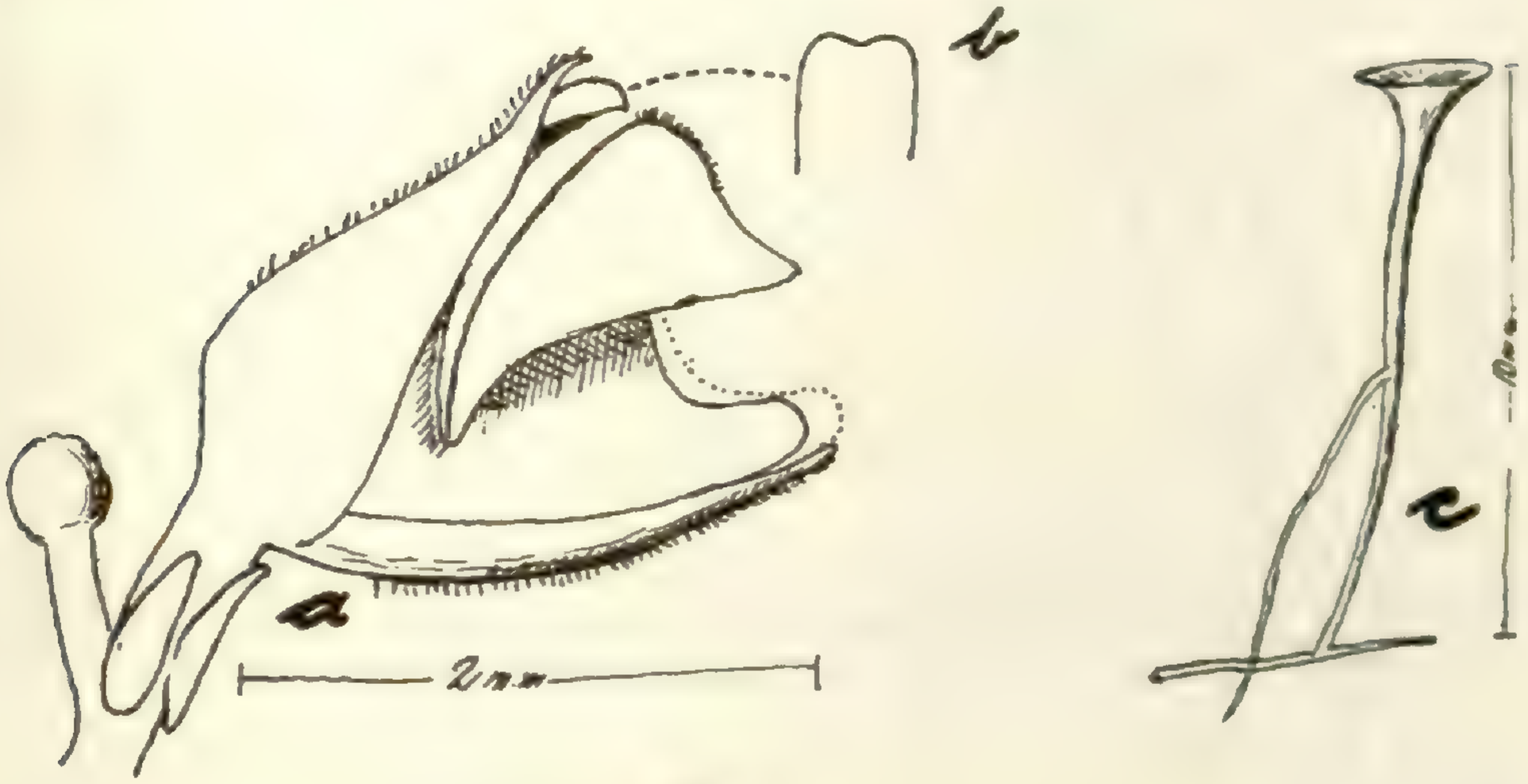


Fig. 4

Utricularia Deightonii Lloyd & Tayl. [apud F. E. Lloyd in Vict. Nat. liii. 101 (1936); The Carnivorous Plants, 259, tt. 25 fig. 1, 31 figs. 6, 7 (1942), *nom. nud.*], sp. nov., affinis *U. peltatae* Spruce ex Oliv., speciei austro-americanae, sed utriculi ostii labio superiore inferius subtruncatum excedenti, palato alato hinc coronam irregulariter crenulatam formanti, corollae etiam labii superioris forma differt.

Terrestrial herb. Leaves peltate; petiole 2 mm. long; lamina orbicular, 2 mm. in diameter, mucilaginous. Scape 1–3-flowered, up to 13 cm. in length. Bracts produced below their point of attachment, sparsely pubescent. Flowers white with purple lip; upper sepal broadly ovate, rounded or obtuse at the apex, sparsely pubescent outside; lower sepal ovate, slightly emarginate, sparsely pubescent outside; upper lip of corolla triangular-concave, narrowed at the apex into an oblong or spathulate emarginate tongue which slightly overhangs the palate on the lower lip, about 3.0 mm. long; lower lip rounded-convex, palate folded (? corrugated) on the top and with the inner edges 3-tuberculate; spur conical, abruptly contracted into a cylindrical prolongation of the apex which projects beyond the rounded lower lip. about 4.5 mm. long. Capsule subglobose, unilaterally dehiscent along the dorsal side.

Hab. SIERRA LEONE: Toni Flats, Waterloo, 16 Aug. 1926. *F. C. Deighton* 2072 (*type* in Herb. Brit. Mus.; Herb. Kew). [Fig. 5.]

This fourth new species with peltate leaves is closely allied to the South American *U. peltata* Spruce ex Oliv. but differs in having the upper lip at the mouth of the trap exceeding the quasi-truncated lower lip, in having the palate winged to form a corona which is irregularly crenulate, and also in the shape of the upper corolla lip.

Deighton 2072

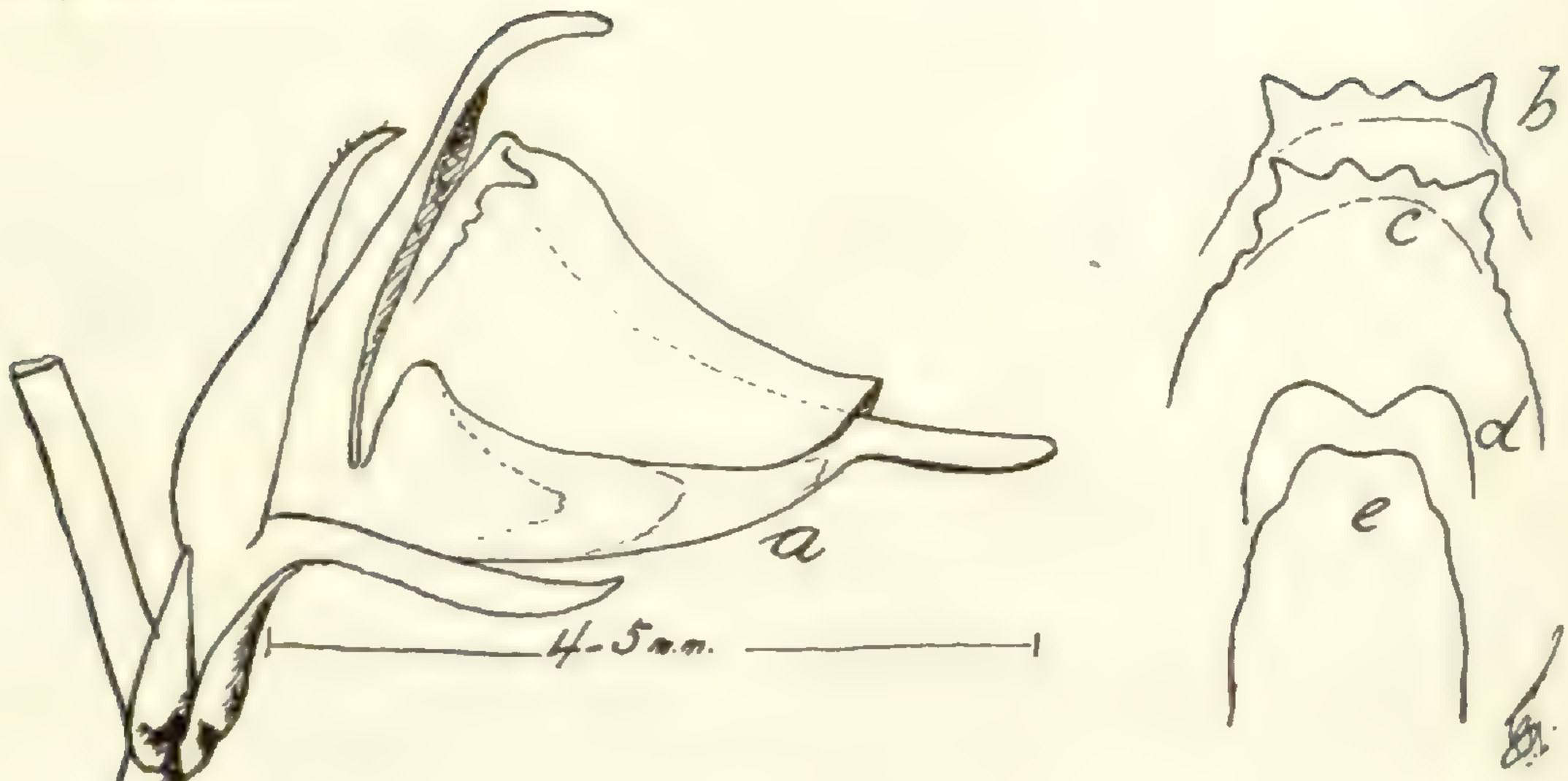


Fig. 5

Fig. 1, A. UTRICULARIA PARADOXA Lloyd & Taylor. Habit of plant, series of leaves (1–6) from different levels of a single branch and (l) tip of a leaf-segment.

Fig. 1, B. Same. a. Bristle from stolon. b. Trap. c. Bifid and quadrifid hairs.

Fig. 1, C. Same. Lateral and front view of flower and lower lip of corolla.

Fig. 2, A. UTRICULARIA HYDROCOTYLOIDES Lloyd & Taylor. a. Flower, lateral view. b. Flower, front view. c. Leaf and stolons.

Fig. 2, B. Same. a. Upper lip of corolla with attached stamen. b. Lower lip of corolla. c. Upper and lower sepals.

Fig. 3, A. UTRICULARIA FERNALDIANA Lloyd & Taylor. a. Flower, lateral view. b. Flower, front view. c. Upper sepal. d. Bracteole.

Fig. 3, B. Same. Base of scape with a young leaf and secondary stolons. Mature leaf (right) with its secondary stolons and a trap.

Fig. 4. UTRICULARIA THOMASII Lloyd & Taylor. a. Flower in lateral view. b. Apex of upper lip. c. Stolon, bearing leaf.

Fig. 5. UTRICULARIA DEIGHTONII Lloyd & Taylor. a. Flower, lateral view. b, c. Lower lip, palate, two different coronae in front view. d, e. Upper lip, two apices.

BRITISH MUSEUM (NATURAL HISTORY).

SOME MEXICAN BEGONIAS

By LYMAN B. SMITH and BERNICE G. SCHUBERT

The three new species here described are all of the collecting of the late Mr. George B. Hinton. All are members of section *Begoniastrum*, subsection *Knesebeckia* and are more closely related to each other than to *B. falciloba* Liebm., also treated here. The latter species has been illustrated in as much detail as possible in the hope that more material will become available for study,

since it is now known to us only from photographs of the cotypes which are in European herbaria. The new species, distinguished by characters emphasized in the key and illustrations, are handsome and a splendid addition to those previously described from Mr. Hinton's exsiccatae.

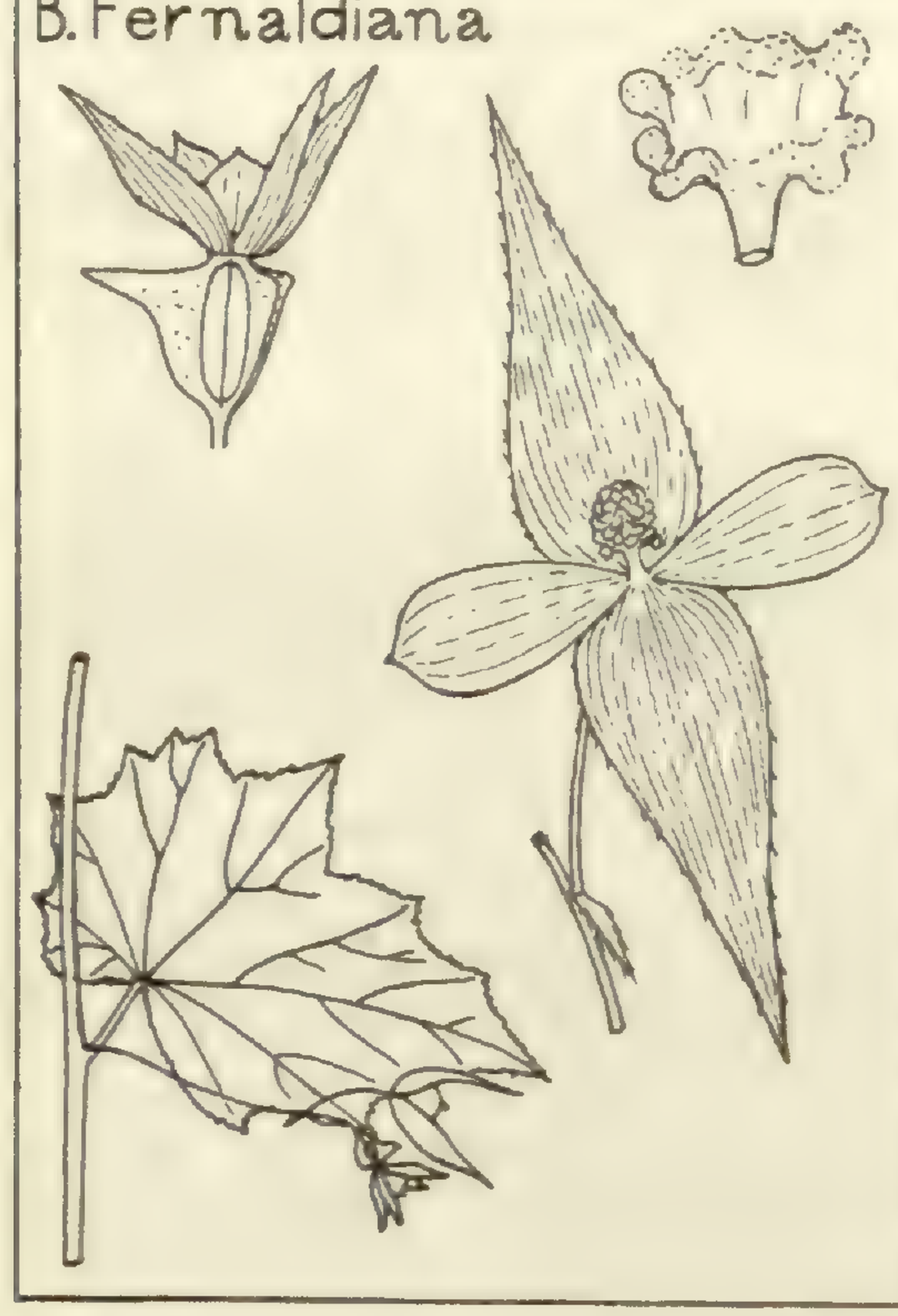
We are very grateful to Mr. E. P. Killip of the United States National Herbarium for the loan of specimens for study and to Dr. H. A. Gleason of the New York Botanical Garden for making available large series of unmounted material of all three Hinton numbers for comparison.

KEY

Inflorescences few- to many-flowered, staminate and pistillate flowers borne on different plants or at least in different leaf-axils; staminate flowers small, outer tepals ca. 1–1.5 cm. long; largest capsule-wing not abruptly widened at apex.
  Outer tepals of staminate and pistillate flowers glabrous; leaf-lobes usually longer than broad ..... *B. falciloba.*
  Outer tepals of staminate and pistillate flowers villous without; styles bifurcate; leaf-lobes shallow ..... *B. nemoralis.*
Inflorescence 1–few-flowered; staminate flowers larger and showy, outer tepals very long (2.5–3 cm.); broadest extension of capsule-wing near apex of capsule.
  Inflorescences usually 3-flowered, staminate and pistillate flowers borne in the same leaf-axil; outer staminate tepals ca. 3 cm. long, long-attenuate; styles irregularly crested; capsule-wings glandular-punctate ..... *B. Fernaldiana.*
  Inflorescences 1-flowered; outer staminate tepals ca. 2.5 cm. long, abruptly acuminate; styles with a flat crest at apex; capsule-wings glabrous to sparsely villous and ciliate ... *B. michoacana.*

BEGONIA FALCILOBA Liebm. Herbaceous; stem glabrous, lineate, leaves obliquely acuminate, irregularly 3–5-lobed, cordate at the base with serrate-dentate margins, sparsely pilose on the upper surface, glabrous on the lower except at the apex of the petiole where there are long reflexed trichomes, ca. 4.5 cm. long, 1.7 cm. broad; petioles glabrous 2.5–7.5 cm. long; stipules lanceolate, glabrous, caducous; inflorescence cymose, few-flowered, bracts ovate-acute, transparent, glabrous, caducous, ca. 3 mm. long, staminate tepals 4, outer 2 ovate-acute, denticulate, glabrous, 1.4–1.8 cm. long, 1–1.2 cm. broad, abruptly narrowed at the base, inner 2 oblong, shorter, entire, 1 cm. long, stamens with short, obovate anthers; pistillate bracteoles broadly ovate, coarsely dentate, transparent, caducous, ca. 6 mm. long, pedicels 2–2.3 cm. long; tepals 3–5, ovate-lanceolate, denticulate, 0.6–1 cm. long, capsule obtuse at base, 8–12 mm. long, largest wing broadly oblong, 12–14 mm. broad, seeds obtuse. Liebm. in Kjoeb. Vidensk. Meddel. for 1852. 15 (1853). Fig. 1.

MEXICO: OAXACA: *Liebmann,* [rec'd.] 1859 (Prodromus Hb., Conserv. Bot., Geneva); Cordillera, *Galeotti, 193* (General Hb., Conserv. Bot., Geneva); *Jurgensen, 807* (Hb. Boissier, Geneva; Hb. Lemann, Cambridge Univ.).



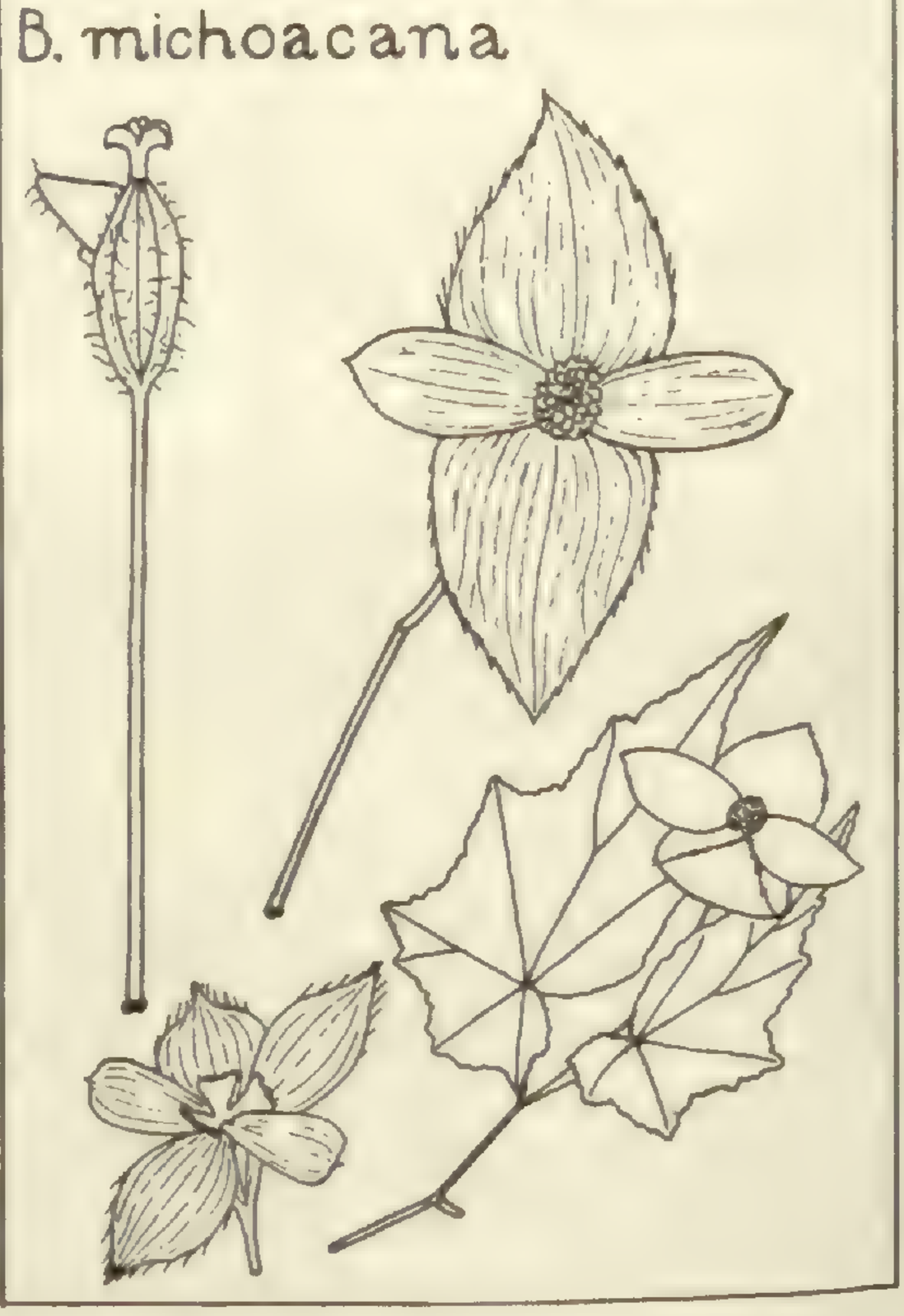


Fig. 1, BEGONIA

The basis for the illustrations of *B. falciloba* is the photograph of the Liebmann material preserved in Geneva. For the privilege of photographing these and other authentic specimens of *Begonia* we are especially grateful to the courtesies extended to the junior author by Dr. Charles Baehni, Director. For use of the facilities at the Botany School, Cambridge, we are indebted to the Director, Dr. F. T. Brooks and to Dr. J. G. Hawkes of the Imperial Institute of Plant Breeding.

BEGONIA **nemoralis,** spec. nov., herbacea verisimiliter dioica, tuberosa; caule lineato, patenti-villoso, foliis denticulato-ciliatis utrinque pilosis, transverse ovato-attenuatis vel ovatis, basi cordatis vel angulatis, 13–19 cm. longis, 8.5–13 cm. latis; petiolis lineatis, patenti-villosis, 5–10 cm. longis; stipulis fimbriato-ciliatis, extus pilosis, cuneatis, 1 cm. longis, 0.5 cm. latis (in basi); inflorescentiis axillaribus, cymosis, bracteis mox deciduis, pedicellis masculinis tenuibus, villosis, 2 cm. longis vel minus, tepalis 4, duobus exterioribus ovatis, brevi-acuminatis, ciliato-serratis, extus pilosis, ± 1.3 cm. longis, ± 0.65 cm. latis, duobus interioribus anguste vel late ellipticis, obtusis,—1.2 cm. longis, 0.38–0.42 cm. latis, extus glabris; staminibus numerosis, filamentis in parte superiori columnae adherentibus, antheris brevibus, obovatis; pedicellis femineis 1.4–3 cm. longis, tepalis 3–5, ovato-acutis vel -acuminatis, extus villosis, una (vel duo) excepta cum marginibus serrato-ciliatis et ea integra vel crispata, 6–7.5 mm. longis, 5–8.5 mm. latis; stylis 3, irregulariter cristatis, breviconnatis; capsulis 3-alatis, ± 1.5 cm. longis et 1.3 cm. latis, glanduloso-villosis cum trichomatibus longis, alis ciliatis marginiformibus vel una maiori et obtusa, placentis bilamellatis, utrinque ovuliferis, seminibus obovatis, reticulatis. Fig. 1.

MEXICO: MICHOACAN: dist. Coalcoman, woods by the Ixtala River, Barroloso, alt. 1200 m., Aug. 7, 1939, *Hinton et al., 15063* (G, TYPE; NY, US, ISOTYPES).

BEGONIA **Fernaldiana,** spec. nov., tuberosa; caule lineato, sparse villoso; foliis petiolatis, asymmetricis transversisque, cordatis, 5–7-nerviis et -lobatis, denticulato-ciliatis; petiolis—2.5 cm. longis caule simile (i. e. lineatis villosisque), foliis utrinque remote villosis; stipulis mox deciduis, oblongis fimbriatisque, inflorescentiis axillaribus, paucifloris, bracteis stipulis similibus sed saepe deltoideis, ca. 7 mm. longis, 3 mm. latis; pedicellis glanduloso-punctatis, remote villosis, ca. 2 cm. longis; tepalis masculinis 4, duobus exterioribus ovato-attenuatis, acuminatis, ciliatodenticulatis, extus punctatis villosisque, maturis ca. 3 cm. longis et 1.3 cm. latis, duobus interioribus obovatis, apiculatis vel breve acuminatis, marginibus integris, 1–2 cm. longis, 0.6–0.8 cm. latis, staminibus numerosis in columna insertis, antheris obovoideis, quam filamentis multo brevioribus; bracteolis verisimiliter mox deciduis; tepalis femineis 5 vel 6, anguste ovato-acuminatis, ciliatis, exterioribus saepe extus punctatis villosisque, ± 1.5 cm. longis, 0.6 cm. latis, interioribus gradatim minoribus, stylis 3,

bifidis, apice papillatis; capsulis glanduloso-punctatis villosisque, obdeltoideis, alis 3 (vel 4 cum una rudimentaria), acutis, glanduloso-punctatis. Fig. 1.

MEXICO: GUERRERO: dist. Mina, bank in oak woods, Manchon, alt. 1200 m., Sept. 2, 1936, *Hinton et al., 9425* (G, TYPE; NY, US, ISOTYPES).

We are happy to name this very striking species for Professor Merritt Lyndon Fernald of the Gray Herbarium.

BEGONIA **michoacana,** spec. nov., succulenta, tuberosa; caule lineato, sparse villoso, foliis rectis vel transversis, asymmetricis, ovato-acuminatis, palmati- 5–7-nerviis, lobo longissimo attenuato, serrato-ciliatis, subtus moderate villosis; petiolis lineatis, villosis ad 4.5 cm. longis; stipulis persistentibus, deltoideis vel ellipticis, lacerato-ciliatis, 6.5–7 mm. longis, 3 mm. latis; inflorescentiis axillaribus, verisimiliter unifloris; bracteis stipulis similibus, mox deciduis, pedicellis masculinis 12–22 mm. longis, sparse villosis, tepalis masculinis 4, duobus exterioribus ovato-acuminatis, ciliato-serrulatis extus villosis, 1.5–2.6 cm. longis et 1.7 cm. latis, duobus interioribus ellipticis vel elliptico-lanceolatis, abrupte acutis, marginibus integris, ca. 2 cm. longis et 0.7 cm. latis; staminibus numerosis filamentis in tota columna insertis, antheris parvis, obovoideis; tepalis femineis 5, exterioribus ovato-lanceolatis, extus villosis, marginibus leviter serrulatis ciliatisque, interioribus ellipticis, plus minusve integris, ca. 1.1 cm. longis, 0.8 cm. latis, stylis 3, in apice cristatis; capsulis ellipticis, 3-alatis, ala maxima triangulata, glabra vel sparse villosa ciliataque, alteris margini-formibus, capsula villosa, placentis bilamellatis utrinque ovuliferis. Fig. 1.

MEXICO: MICHOACAN: dist. Apatzingan, forest barranca, Aguililla, alt. 800 m., Sept. 18, 1939, *Hinton et al., 15186* (G, TYPE; NY, US, ISOTYPES).

EXPLANATION OF FIGURE

For all species: sections showing leaves, × ½; flowers and fruits, × 1; separate stamens and styles, × 5. The basis for the illustration of *B. falciloba* is discussed under that species, the basis for each of the new species is, in each case, the type, in the Gray Herbarium.

GRAY HERBARIUM

ADDITIONS TO THE FLORAS OF SOUTHAMPTON AND MANSEL ISLANDS, HUDSON BAY

By NICHOLAS POLUNIN

Already before the end of the last century our *maestro* published (Fernald 1899) an interesting and almost pioneering list of the vascular plants collected by a whaling captain, George Comer, during 1893–4 on the northwest coast of Hudson Bay. This was followed by an account of the plants collected by R. Robin-

son during the expedition of Commander Donald B. MacMillan in the proximal parts of Baffin Island in the summer of 1922 (Fernald 1923). In between lies the considerable Southampton Island, some of whose approximately 20,000 square miles have been investigated in more detail (Raup 1936; Polunin 1938a, 1940, MS.a).

The first recorded botanical exploration of Southampton Island was carried out by Sir W. E. Parry (cf. 1824) and certain of his officers (Edwards, Fisher, Hooper, Lyon) in 1821 and concerned only parts of the northern coastal regions of the island. During brief landings forty-eight species of vascular plants were collected (cf. Polunin 1938a, 1940), of which twenty-eight were recorded by the elder Hooker (1825a) from the gatherings of Parry and Edwards. In 1824 Lyon revisited the region with his own expedition (Lyon 1825; Hooker 1825b) and gathered plants "upon a few low islands which were met with in, or near, the position assigned to Southampton Island"; these records, owing to the uncertainty of the locality or localities of collection, ought probably to be ignored. Thereafter, except for a single specimen taken by Dr. L. E. Borden in 1904, it appears that no botanical work was attempted on Southampton Island until 1922, when Therkel Mathiassen and Jacob Olsen of the Danish Fifth Thule Expedition collected some plants as recorded by Grøntved (1936). In 1928 the island was visited for the first time by a trained botanist, the late Dr. M. O. Malte (then Chief Botanist of the National Museum of Canada), who informed the writer that he had obtained about eighty species in the single day he had ashore near the Hudson's Bay Company's trading post in South Bay. These, according to the present writer's computation, included no less than thirty-seven species and subsidiary forms not previously known from the island. Two summers later Dr. G. M. Sutton made a collection which added a further twenty-six to the species and forms hitherto gathered on the island. In 1933 Southampton Island and some closely adjacent smaller islands were visited by the Norcross-Bartlett Expedition, a few plants (including some interesting additions) being collected by J. B. Angel. The following year, and again in 1936, the present writer visited South Bay for brief periods during Canadian Eastern Arctic Expeditions, making primary ecological surveys of the chief plant communities and also collections and notes which resulted in further additions to the known flora. Meanwhile Messrs. T. H. Manning, P. D. Baird, and G. W.

Rowley had also been collecting plants industriously in various parts of Southampton Island and on one of its adjacent islets.

In the gatherings of the above-mentioned fifteen collectors, from Southampton Island or the immediately adjacent smaller islands that seem properly to belong to it phytogeographically, the present writer has found represented no less than one hundred and fifty-one species and twenty subsidiary forms of vascular plants (Polunin 1938a), another species being added later (Polunin 1940); again in 1946 he spent some days on the island during the second half of August and, especially during a trek inland from near the head of South Bay (MS.b), made additions to the known flora which it is one of the objects of this contribution to record. The most noteworthy of these additions (which are all from the general region of Coral Harbour) are as follows, the order and nomenclature here and in the list given below from Mansel Island being in general those of the author's "Botany of the Canadian Eastern Arctic, Part I, Pteridophyta and Spermatophyta" (1940):

PHIPPSIA ALGIDA (Soland. apud Phipps) R. Br. Several typical gatherings of this were obtained around snow-patches, both near the coast in the vicinity of the airfield at Coral Harbour and up to about 15 miles inland. In addition there were found some *Puccinellia*-like specimens that seem needful of critical study. *Phippsia algida* is well known from almost all parts of the Canadian Eastern Arctic, including three of the smaller Islands of district "9. Islands in Hudson, etc., Bays" (Polunin 1940, p. 63, sub. syn. *Catabrosa algida*). Long expected on Southampton Island (cf. Polunin 1938a, p. 94).

POA ALPINA L. forma BREVIFOLIA (Gaudin) Polunin. No. 17723: about 8 miles north of the airfield, Coral Harbour. Only the typical form of this familiar species, which is widespread in the southern half of the Canadian Eastern Arctic, has hitherto been recorded from Southampton Island, although f. *brevifolia* is already known from Akpatok and Mansel Islands in district 9 (Polunin 1940, p. 76).

FESTUCA BAFFINENSIS Polunin. Nos. 17236, 17265, 17428, 17446, 17461: limestone terrain around the airfield and near the sea. As with the Mansel Island specimens (*see* below), this material has for the most part dense and dark (but not "very"), ovoid (but not "broadly") panicles, and densely tomentose (but not "very"), stoutish culms that make it seem nearer to *F. baffinensis* than to *F. brachyphylla* Schultes (cf. Fernald 1935, p. 251). The anthers, moreover, are barely 0.5 mm. long. No. 17398, also from limestone terrain near the coast, lacks the dark colour of the glumes and upper portions of the pales and in appearance approaches *F. brachyphylla* f. *flavida* Polunin, which latter, however, has the culms and anthers of *F. brachyphylla*. *F. baffinensis* is an addition to the

recorded flora of district 9 of the Eastern Arctic (Polunin 1940, p. 93, and cf. below). More or less typical *F. brachyphylla* was found on the granitic terrain inland.

Eriophorum spissum Fernald. Three gatherings of this were made on granitic terrain north of the airfield, in sheltered, marshy depressions where the vegetation looked relatively stable. The species is plentiful in most of the southern half of the Canadian Eastern Arctic but has not previously been recorded from any part of district 9 (cf. Polunin 1940, pp. 101–2).

Carex supina Wahlenb. Nos. 17598 and 17630: dry sandy ridges about ten and twelve miles from the coast, north of the airfield. New to district 9, and indeed previously recorded in the Canadian Eastern Arctic only from central and southern Baffin and the west coast of Hudson Bay (*ibid.* p. 121).

Carex glacialis Mackenzie. Locally plentiful on calcareous gravel inland of the airfield: widespread in the Canadian Eastern Arctic and already recorded from Akpatok and Coats Islands in district 9 (*ibid.* p. 121).

Carex Williamsii Britton. Nos. 17655 and 17662: sheltered depressions about the banks of the Kirchoffer River some miles north of the airfield. Not previously recorded from the arctic archipelago but fairly widespread in the mainland regions of the extreme south of the Canadian Eastern Arctic (*ibid.* p. 124).

Koenigia islandica L. A single collection of this was gathered between moss tussocks on the humous bed of a dark marshy depression some miles inland, north of the airfield. The species is widespread in the Canadian Eastern Arctic but in district 9 has so far been reported only from Mansel Island (*ibid.* p. 175). Long expected on Southampton Island (cf. Polunin 1938a, p. 94).

Lychnis apetala L. forma **palea,** nova forma.—Calcye vivente omnino viridi vel albido-virescente, siccato pallido venis quam superficie inter eas vix fuscioribus, sicut pilis haud purpureis.

Occasional patches of this striking though apparently minor variant were found on limestone terrain near the coast, where the typical form was plentiful. They gave the impression of being genetic rather than nutritional. Coral Harbour, Southampton Island, 17 August, 1946, Polunin No. 17465 TYPE.

Cerastium Beeringianum Cham. and Schlechtend. Nos. 17472 and 17482 from limestone terrain near the coast, although still varying in such characters as the shape of both cauline and radical leaves and the length of the calyces, have short capsules and small seeds as well as being slender and little-hairy and so seem properly referable to this problematical segregate of the polymorphic *Cerastium alpinum*, as was kindly confirmed for me by Mr. A. E. Porsild, Curator of the National Herbarium of Canada. No. 17451, also from limestone terrain near the coast, is less characteristic, having calyx-lobes up to 7 mm. long; however, it seems

indistinguishable in almost all respects from a Keewatin specimen in the National Herbarium of Canada (Rankin Inlet, *Macoun* 1910, No. 79083) determined by Fernald and Wiegand (cf. 1920, p. 173) as *C. Beeringianum*, and probably belongs also to this species. Apart from this Rankin Inlet specimen on which the definite report of this species from the Canadian Eastern Arctic alone rested, tentative, queried suggestions exist from various parts of Baffin Island (Polunin 1940, p. 189).

ARENARIA HUMIFUSA Wahlenb. This characteristic and now familiar calcicolous species was encountered over and over again on limestone terrain near the sea and around the airfield, but appeared to be less plentiful inland. Although widespread elsewhere in the Canadian Eastern Arctic it has not previously been recorded from any part of district 9 (*ibid.* p. 199).

ARENARIA SAJANENSIS Willd. apud Schlechtend. Collected on six occasions around snow-patches near the coast and in sheltered, sandy depressions inland about the Kirchoffer River: in the latter situations so floriferous and rampant as to be superficially reminiscent of *A. marcescens* Fernald (1919, p. 15, and cf. 1933, pl. 255). *A. sajanensis* is already known to be widespread in the southern half of the Canadian Eastern Arctic, including two of the other islands of district 9 (Polunin 1940, p. 204).

SAGINA CAESPITOSA (J. Vahl) Lange. A few individuals of this frequently overlooked dwarf were detected on limestone terrain near the coast, and again inland although unfortunately no note was there kept of the substratum. In spite of being easily overlooked, the species is known to be widespread in the southern half of the Canadian Eastern Arctic, although it has not previously been recorded from district 9 (*ibid.* p. 207).

DRABA **Fernaldiana,** species nova.—Planta nana, perennis, florifera 1 cm. alta, fructifera (siliquis inclusis) 1.5–4 cm. alta; radice simplici et cespite unico vel radice ramosa et cespitibus aggregatis; foliis vivis fulgenter viridibus, divergentibus, lucidis carnosulisque, ad sese frictis stridulis, late oblanceolatis vel obovatis, 3–10 (–20) mm. longis, 1.5–3 (–6) mm. latis, apice rotundatis, plus minusve marcescentibus et dein obscure brunneis vel cinereis, supra et subtus plerumque glabris sed marginibus plerumque pilis albis elongatis grosse ciliatis vel non nunquam pilis minoribus furcatis vel stellatis intermixtis vel eis omnino substitutis; caulibus solitariis brevissimis et maxima ex parte a foliis occultatis, scapiformibus, validis, rigidis, viridibus, plerumque cum siliquis glabris; inflorescentia simplici, racemosa vel raro subumbellata; pedicellis angulo 30°–60° formantibus, floriferis 2 mm. longis, fructiferis ad 6 mm. longis; sepalis viridescentibus, late obovatis, ca. 1.3 x 2 mm.; petalis pallide flavis, unguiculatis, ca. 2 x 3.5 mm., lamina suborbiculari; antheris parvis; siliquis maturis adscendentibus, laevibus, ovatis vel late ovatis, 3–4 x 4–6.5 mm., stylo brevi sed distincto, infra 0.5 mm. longo stigmate capitato incluso; seminibus plerumque 6 in loculo, atrobrunneis, maturis 1.4 mm. longis, testa minute punctata.

Coral Harbour, Southampton Island: gravelly ledge at side of slightly sheltered depression in limestone 'barrens', fruiting, 17 August, 1946, Polunin No. 17415 TYPE. Also No. 17430, flowering, from bed of same depression, same date, and No. 17581, flowering, from a late-snow patch at the foot of a granitic 'step-up', 18 August, 1946. Some of the dimensional and other data not available from the type were obtained from co-type material or the flowering specimens.

This attractive little *Draba* has puzzled the writer for more than a decade, but, now that he has observed it more carefully in the field (his first specimen was "a doubtful scrap gathered in a hurry in semi-darkness" (Polunin 1938a, p. 100)), it is felt to have nothing to do with *D. crassifolia* Graham, to which it was at first tentatively referred (with a query—cf. also 1940, pp. 239–40), but from all known phases of which *D. Fernaldiana* is immediately distinguished by its 'close' habit and stout axis, its coarser leaf-ciliation, and the shape and dimensions of its floral parts and fruits; in every respect it seems more closely related to the *D. fladnizensis* complex (cf. ibid. p. 239). In 1946 plentiful material of *D. Fernaldiana* in both flowering and fruiting stages was obtained, whence with field notes the above description was prepared. It gives the writer great pleasure to name this apparently undescribed but highly characteristic and altogether charming little plant after Professor Fernald who has done so much to elucidate this notoriously difficult genus in Eastern North America (cf. especially Fernald 1934); may he enjoy many many years of happy and productive 'retirement' in the Gray Herbarium!

ARABIS ARENICOLA (Richardson) Gelert var. PUBESCENS (Watson) Gelert. Although most of the Coral Harbour material of this species has the laminae glabrous even if the petioles may bear marginal strigosities, No. No. 17309 from limestone terrain near the sea and two plants in No. 17698 from well inland have the laminae plentifully beset with coarse, branched hairs and so belong to var. *pubescens*, which has not previously been recorded from district 9 (Polunin 1940, p. 247).

DIAPENSIA LAPPONICA L. Encountered several times inland, to the north of the airfield. Fairly plentiful in many parts of the southern half of the Canadian Eastern Arctic but in district 9 hitherto reported only from Akpatok and Coats Islands (*ibid.* p. 318).

ANTENNARIA cf. COMPACTA Malte. Nos. 17545 and 17694: dry sandy (acidic?) terrain well inland, to the north of the airfield. Known to be fairly widespread, if uncommon, in the southern half of the Canadian Eastern Arctic at least in the east, but not previously recorded from any part of district 9 (*ibid.* p. 353). This material is not wholly typical but, as was suggested by Mr. A. E. Porsild, seems better placed here than in

A. canescens (Lange) Malte, to which the writer had first thought it might be referable. In any case it constitutes an addition to the known flora of district 9 (*ibid.* pp. 350 and 353).

ANTENNARIA **Fernaldiana,** species nova.—Planta nana, perennis, florifera 2–5 cm. alta, fructifera haud ultra 10 cm. alta, simplex vel ramosa cum stolonibus paucis brevibus foliaceis e rhizomate centrali obliquo reliquiis atro-brunneis foliorum vestito divergentibus; radicibus elongatis, gracillimis, mollibus, flexuosis, plerumque simplicibus; foliis basilaribus plus minusve dense rosulatis, patentibus vel paulo adscendentibus, plerumque spathulatis, muticis vel mucronatis, ca. 1.5–3.5 mm. latis et 4–9 (–12) mm. longis, utrinque lanato-canescentibus; foliis caulinis 5–10, subaequaliter inter se distantibus, linearibus vel lineari-oblanceolatis, (4–) 7–13 mm. longis, maximum 1.4 mm. latis, plerumque minus villosis quam foliis radicalibus ergo quam foliis basilaribus viridioribus, parte terminali plerumque obtusa, glabra, 2–3 mm. longa, scariosa, basem versus saturate brunnea, superne pallide brunnea excepta; caule florifera erecto, laxe lanato, plerumque monocephalo sed subinde capitulo minore laterale (rarissime capitulis duobus lateralibus) auctis; capitulis (ex sicco et in herbario applanatis) ca. 7–10 mm. altis et 8–12 mm. latis; bracteis obscure 2–3-seriatis, quidpiam imbricatis, apice subaequalibus, 5–6 mm. longis, 1–2 mm. latis, exterioribus ex sicco plus minusve recurvatis, oblongis vel spathulatis vel obovatis, apice plerumque obtuso erosoque, basi extus viridibus plus minusve lanatis, centro saturate viridibus, dimidia parte apicali striata, glabra, saturate olivacea vel livida (atro-cinerea vel brunnescente delapsa sed non exsiccata); pappo strigoso, albescenti, cypselis ca. 16-lobatis; corollis siccis brunnescentibus vel purpureo-brunneis; stylo sicco apice brunneo, plerumque breviter exserto, stigmatibus vix divergentibus; receptaculo profunde excavato; achaeniis laevibus, brunnescentibus, maturis siccisque ca. 1.0–1.5 mm. longis.

Inland of Coral Harbour, Southampton Island: dryish, lichen-rich sandy heath about twelve miles inland, north of the airfield, 20 August, 1946, Polunin No. 17728 TYPE. Also within a few miles were gathered in similar situations on the same or immediately following days Nos. 17607, 17609, 17621, 17663, 17664, 17674, 17692, and 17738, all of which appear to belong to this species, and from some of which the above description was partly drawn. In nos. 17609, 17621, 17674, and 17738 occurred plants (separated as "a") that appeared to have hermaphrodite florets, but with the fruits apparently mature the state was too advanced for this to be determined as the writer was due to leave again for the Arctic. These specimens appeared to have lighter-coloured phyllaries and larger and more divergent corolla lobes, and may yet represent another species.

Here again it gives the writer warm satisfaction to name for his old Chief this charming little plant belonging to a group in which he whom we are honoring has done such distinguished work. *Antennaria Fernaldiana* is apparently allied to *A. pygmaea* Fernald and *A. canescens* (Lange) Malte, being, however,

immediately distinguished from *A. pygmaea* by the conspicuously whitish-tipped, imbricated phyllaries and often glabrate leaves of that species (Fernald 1914, p. 130; Malte 1934, p. 109), and from *A. canescens* by its less spreading and usually monocephalous habit and its much wider phyllaries (the middle and inner ones in *A. canescens* are "linear-lanceolate, long-attenuate" —*see* Malte *l. c.*). Among plants which the writer has seen, *A. Fernaldiana* seems to be nearest to specimens of an undescribed species shown to him by Mr. A. E. Porsild from the better part of 2,000 miles away on the Canol Road; these, however, were more frequently pleiocephalous, less compact, and had larger but proportionately narrower leaves and usually lighter-colored, pinkish corolla tubes.

Taraxacum phymatocarpum J. Vahl. Nos. 17605, 17616, 17624, 17641, all from sandy banks and ridges about ten to twelve miles north of the airfield: showing considerable variation in the shape of the leaves. On only one scape there remained a single fruit, which was strongly tuberculate especially above; but its minutely puberulent lower half was a surprising character. This interesting species is widespread in the insular regions of the Canadian Eastern Arctic, especially in the north, but in conformity with its general infrequency in the south has not previously been reported from any part of district 9 (Polunin 1940, p. 369).

In addition to the above reports of entities new to the flora of Southampton Island, many further species which were previously thought to be rare on the island were found to be relatively plentiful, at all events locally, while not a few the knowledge of whose existence there rested upon a single report were amply confirmed in 1946 when indeed only a very small proportion of the plants hitherto recorded from Southampton Island were not found again. To the previously known one hundred and fifty-one species and twenty subsidiary entities reported in 1938 from Southampton Island should be added the subsequently distinguished *Antennaria Tansleyi* (Polunin 1940, p. 358) and now the above sixteen species and three subsidiary forms. The comparative ease with which additions can still be made suggests that there are many more to come, as in most other arctic lands.

In Hudson Bay to the southeast of Southampton Island, about thirty-five miles off the west coast of Ungava (northernmost Quebec), lies the less extensive but still substantial Mansel Island. Like most of the southern portion of Southampton Island it is of low, flat or rolling limestone and rather poorly

vegetated. So far as is known, Mansel Island was first investigated botanically by Dr. Robert Bell in the summer of 1884. In the botanical appendix to Bell's report (1884), comprising the "List by Professor Macoun of the plants collected . . .", the records are unfortunately obscured by the 'lumping' together, as if they constituted a single locality, of "Mansfield, Digge's and Nottingham Islands, at the western end of the straits" (*sic*). However, the majority of the records are cited individually for Mansel Island in one or another part of Macoun's "Catalogue of Canadian Plants", while Bell's collection, which is disseminated through the National Herbarium of Canada, has been revised by the present writer, who finds represented therein a total of twenty-eight species and two subsidiary entities of vascular plants.

No other scientist is known to have visited Mansel Island until August, 1936, when Mr. Douglas Leechman of the National Museum of Canada, during the Eastern Arctic Expedition of that year, effected a landing for a few hours on the north end of the island. During this brief visit Mr. Leechman gathered specimens of thirty species and three subsidiary forms of vascular plants, of which no less than fourteen species and two subsidiary forms were additional to those collected by Bell. As a result of these two collections, and manuscript reports of three additional species by Malte and Ostenfeld, the present writer was able to record (1938b) forty-five species and four subsidiary forms of vascular plants from the island. These were all Spermatophyta; but it was prophesied that Pteridophyta would in time be found on the island, and already this prophesy has been fulfilled (*see* below).

In the summer of 1946 Mr. and Mrs. T. H. Manning visited Mansel Island and collected plants industriously at both its south (August 16–18) and north (August 20–21) ends. Their ample and beautifully prepared series of specimens comprised about fifty species of vascular plants and included the following that had not previously been recorded from the island:

EQUISETUM ARVENSE L. North end. Already known to occur practically throughout the Canadian Eastern Arctic, including other parts of district "9. Islands in Southampton, etc., Bays" (Polunin 1940, p. 34).

EQUISETUM VARIEGATUM Schleich. South end. Already known to occur in most parts of the Canadian Eastern Arctic, including other portions of district 9 (*ibid.* p. 36).

POA ALPINA L. North and south ends. Already known to occur in many parts of the southern half of the Canadian Eastern Arctic, including

other portions of district 9 (*ibid.* p. 76); f. *brevifolia* (Gaudin) Polunin has already been recorded from the island (Polunin 1938b, p. 7).

COLPODIUM FULVUM (Trin.) Griseb. var. EFFUSUM (Lange) Polunin. North and south ends. Already known to occur practically throughout the southernmost portions of the Canadian Eastern Arctic, including several parts of district 9, although there is no previous record of any member of this complex from Mansel Island.

FESTUCA BAFFINENSIS Polunin. North and south ends. This material has dense and dark (but not "very"), ovoid (but not "broadly") panicles, and densely tomentose (but not "very") culms that make it seem nearer to *F. baffinensis* than to *F. brachyphylla* Schultes. The anthers, moreover, are mostly 0.5 mm. long although some slightly exceed this length. On the other hand the single plant in the National Herbarium of Canada collected by Bell (No. 34717) appears, in such characters as are visible, to belong to *F. brachyphylla* (cf. Polunin 1938b). *F. baffinensis* has not previously been reported from south of Cape Dorset, Baffin Island, and although it is now known to occur on Digges and Southampton Islands, the present report constitutes a slight range-extension and also, with the Southampton Island report, an addition to the known flora of district 9 of the Canadian Eastern Arctic (Polunin 1940).

ELYMUS ARENARIUS L. approaching var. VILLOSISSIMUS (Scribner) Polunin. North and south ends. In spite of the narrowness and length of the glumes which may attain 2 cm., it seems that these plants approach more closely the northern than the more southerly New World variety (var. *villosus* E. Meyer) of this species which is well known from most coastal regions of the southern half of the Canadian Eastern Arctic but has not previously been recorded from Mansel Island, although it is already known to be plentiful in other parts of district 9 (*ibid.* p. 98).

ERIOPHORUM ANGUSTIFOLIUM Honck. North end. Well known to occur practically throughout the Canadian Eastern Arctic, including almost all other parts of district 9 (*ibid.* p. 104).

LUZULA NIVALIS (Laest.) Beurl. North end; a single but unmistakable scrap. Already known to occur practically throughout the southern half of the Canadian Eastern Arctic, including almost all other parts of district 9 (*ibid.* p. 141).

SALIX HERBACEA L. North end. Already known to occur practically throughout the southern half of the Canadian Eastern Arctic, including almost all other parts of district 9 (*ibid.* p. 156).

ARENARIA PEPLOIDES L. var. DIFFUSA Hornem. North end. Already known to be generally distributed around coasts over the southern half of the Canadian Eastern Arctic, including most other parts of district 9 (*ibid.* p. 198). Neither the typical form nor the locally more familiar var. *diffusa* has previously been reported from Mansel Island (cf. Polunin 1938b).

EUTREMA EDWARDSII R. Br. North end. Already known to occur practically throughout the Canadian Eastern Arctic, including most other parts of district 9 (Polunin 1940, p. 229).

Saxifraga nivalis L. North and south ends. Already known to occur practically throughout the Canadian Eastern Arctic, including most other parts of district 9 (*ibid.* p. 262).

Saxifraga Hirculus L. var. propinqua (R. Br.) Simmons. Besides the typical form, which has already been reported from Mansel Island, there occur at both the north and south ends specimens that seem to be nearer to this northern variety which is already known from most parts of the Canadian Eastern Arctic including much of the rest of district 9 (*ibid.* p. 267). One of the Mannings' specimens from the south end of Mansel Island looks to me good var. *propinqua*—and so, I am now bound to admit, does Bell's old specimen in the National Herbarium of Canada.

Chrysosplenium alternifolium L. var. tetrandrum Lund. North and south ends. No gathering of this genus has previously been reported from Mansel Island, although the above form is well known from other parts of district 9 and indeed practically throughout the Canadian Eastern Arctic (*ibid.* p. 370). Although on the basis of cytological and other work it would seem preferable to accord specific rank to these northern plants "having only four stamens and smaller and more rounded leaves with fewer crenulations", the writer reserves judgment pending further investigations in the light of recent revisions.

Hippuris vulgaris L. South end. Already known from numerous stations in the southern two-thirds of the Canadian Eastern Arctic, although in district 9 it has previously been reported only from Nottingham and Southampton Islands (*ibid.* p. 304).

Mertensia maritima (L.) S. F. Gray var. tenella Th. Fr. North end. As this usual arctic variety, the species is already known from coasts almost throughout the southern two-thirds of the Canadian Eastern Arctic, although in district 9 it has previously been reported only from Nottingham and Southampton Islands (*ibid.* p. 324).

Chrysanthemum integrifolium Richardson. North end. Already known to be widespread in the insular portions of the Canadian Eastern Arctic, including most parts of district 9 (*ibid.* p. 362).

Thus are added fifteen species and two subsidiary forms of vascular plants to the hitherto recorded flora of Mansel Island, making a total of sixty species and six subsidiary forms now known from the island.

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STUDIES IN THE IRIDACEAE,—IV

By Robert C. Foster

This short paper records the extension of *Sphenostigma* subgenus *Eusphenostigma* from South to North America, with the description of a new species, discusses the nomenclature of *Moraea pavonia* (L. f.) Ker and describes a new genus of South American irids, a segregate from *Cypella*. Aside from the material in the Gray Herbarium, specimens have been seen from the United States National Herbarium, the New York Botanical Garden and the Chicago Natural History Museum. To the administrative officers of these institutions I am indebted for their kindness in lending me this material.

1. A New Mexican Sphenostigma

Among some miscellaneous specimens of Mexican *Iridaceae*, sent to me for determination by the Chicago Natural History Museum, there was one which proved to be an undescribed species of *Sphenostigma*.

Sphenostigma **Conzattii,** spec. nov. Bulbus anguste ovoideus, 1.7–2.3 cm. altus, 1–1.5 cm. latus, tunicae atrobrunneae, sursum in collo longo (3–5 cm.) prolongatae. Folia basalia 2–5, 9–25 cm. longa, 0.25–1 mm. lata, lineari-filiformia, glabra, apice acerosa; folium caulinum unicum, basem spatharum amplectens, 5–9 cm. longum, lamina lineari-filiformis. Caulis simplex, teres, glaber, 21–25 cm. longus. Spathae pauciflorae (ad 4 ?), exterior quam interiorem longior, 3–4.5 cm. longae. Pedicelli filiformes, glabri, quam spathas breviores, apice paullum curvati, flores subnutantes. Ovarium glabrum, oblongum vel subturbinatum, 2–3 mm. longum. Tepala perinaequalia, alba (fide Conzatti); tepala exteriora elliptico-ovata, ad 1.8 cm. longa, 7 mm. lata, subobtusa; interiora ad 7 mm. longa, lamina suborbicularis 4 mm. longa, apiculo longo (2–3 mm.). Filamenta libera, ad 4 mm. longa; antherae ca. 6 mm. longae. Stylus 1 cm. longus; styli rami ca. 2 mm. longi, profunde retusi. Capsula immatura oblonga, 7 mm. longa; semina non visa.—MEXICO: Oaxaca: Camino Montelobos, de Nopalera à Huitzo, 2000 m. alt., June 23, 1907, *Conzatti*, no. 1904 (type, F).

This new species, named for the collector, Professor Conzatti, is quite unlike any other North American species of the genus. Superficially, in its vegetative aspect, it resembles *S. longispathum* var. *filiforme* R. C. Foster in its very narrow basal leaves, and in the terminal cauline leaf immediately subtending the spathes and appearing to be a continuation of the stem. In *S. Conzattii*, however, the basal leaves are more numerous and

the bulb-tunics are prolonged upward in a long collar around the base of the stem. The technical characters of the style are close to those of *S. Hintonii* R. C. Foster. From all other North American species, however, it can be distinguished at once by the fact that its white flowers have the inner and outer tepals markedly dissimilar in size and shape.

From the point just mentioned, it is clear that *S. Conzattii* belongs in the subgenus *Eusphenostigma;* it is thus the first member of that subgenus to be known outside of South America. This fact necessitates an amendment of my recent revision of the North American species of *Sphenostigma*.[1] The key must be altered as follows:

a. Outer and inner tepals very dissimilar in size and shape (subgenus *Eusphenostigma*). *S. Conzattii*
a. Outer and inner tepals subequal (subgenus *Cardiostigma*).

The remainder of the key can then follow, without change.

2. The Nomenclature of Moraea pavonia

Confusion and misunderstanding have attended *Moraea pavonia* (L. f.) Ker since its original (and wholly inadequate) description as *Iris pavonia* L. f., based on specimens collected by Thunberg. N. E. Brown, in Trans. Linn. Soc. xlviii. 38 (1928), has noted that there is no specimen of *I. pavonia* in the Linnaean Herbarium, and that consequently the specimens in Thunberg's own herbarium must serve as the standard of reference. Brown noted, too, that of the three sheets labeled *I. pavonia* in Thunberg's herbarium, two are *Homeria elegans* (Jacq.) Sweet, while the third contains a mixture of two species of *Moraea*. One of these, from which Thunberg's figure of *I. pavonia* was drawn, Diss. Irid. t. 1 (1782), is true *Moraea pavonia*. The other, matching the figure of *M. pavonia* in Bot. Mag. xxxi. t. 1247 (1809), is probably what has since been described as *M. tulbaghensis* L. Bol. in S. Afr. Gard. xxii. 276 (1932).

The differences between *M. pavonia* (*sensu stricto*) and *M. tulbaghensis* have not been pointed out in sufficient detail. As Dr. Bolus noted, the inner perianth-segments of the latter species have obtuse lateral lobes so that they are more or less tricuspidate. In *M. pavonia*, however, these segments are entire and lanceolate, or even, as in Thunberg's figure, somewhat oblanceolate. *Iris pavonia*, as described by Thunberg, was reported to have nectaries at the bases of the outer tepals. This detail was

[1] See Contrib. Gray Herb. clv. 9–17 (1945).

presumably taken from the other *Moraea*-element involved, for Jacquin, Coll. Suppl. 8 (1796), describing what he took to be *I. pavonia*, reported that the nectaries were absent in his plants. The greatest point of difference lies in the style-arms and style-crests. In *M. pavonia*, the style-arms are less markedly petaloid, and the style-crests are short, obtusely rounded and not petaloid, In the other species, the style-arms are petaloid, and the style-crests are large, conspicuous, more or less lanceolate, acute and petaloid, as in most species of *Moraea*.

With the rediscovery of true *M. pavonia* by Prof. T. T. Barnard (see S. Afr. Gard. xxii. 276 (1932)), the examination of the Thunbergian material by Dr. N. E. Brown, and the segregation and description of *M. tulbaghensis* by Dr. Louisa Bolus, most of the confusion surrounding *M. pavonia* has been cleared away. It is, therefore, unfortunate that the binomial *Moraea pavonia* (L. f.) Ker (1804) is a later homonym of *M. pavonia* (L. f.) Thunb. Diss. Moraea, 14 (1787), the latter being the American plant now known as *Tigridia pavonia* (L. f.) DC. So far as I can discover, there is no synonym available which can be taken up and used for the South African species. Although Baker, Handbk. Irid. 59 (1892) and Fl. Cap. vi. 24 (1896), treated *M. villosa* (Ker) Ker as a variety of *M. pavonia*, I cannot agree, and regard it as a distinct species. Certainly, with its tricuspidate inner perianth-segments and petaloid style-crests it can hardly be conspecific with true *M. pavonia*. A second variety, var. *lutea* (Ker) Baker, likewise has tricuspidate inner perianth-segments and petaloid style-crests, so that I agree with Dr. N. E. Brown who treated it as distinct, naming it *Moraea Bellendeni* (Sweet) N. E. Br. in Kew Bull. 1929: 139. Curiously enough, the same combination had already appeared in Fl. Cap. vi. 556, in the index, where it was incorrectly attributed to Sweet and was printed in italics, indicating that it was a synonym. A new combination accidentally made in an index, in synonymy, is certainly not valid and could not bar Brown's transfer.

As a result, *M. pavonia* (L. f.) Ker is left without a synonym and must be renamed:

Moraea **neopavonia,** nom. nov. *Iris pavonia* L. f. Suppl. 98 (1781); Andr. Bot. Rep. vi. t. 364 (1804); but not Jacq. Hort. Schoenbr. i. t. 10 (1797). *Vieusseuxia pavonia* (L. f.) DC. in Ann. Mus. Hist. Nat. ii. 138 (1803), at least as to basonym, but possibly not as to plant (see N. E. Brown in Kew Bull. 1929: 139). *Moraea pavonia* (L. f.) Ker in Koen. & Sims, Ann. Bot. i. 240 (1804), not *M. pavonia* (L. f.) Thunb. Diss. Mor. 14 (1787).

3. A New Genus from South America

For some time, the appearance of certain plants usually classed as *Cypella* has caused me misgivings. Now that detailed study of their floral structures has been made, it is clear that three closely related species are involved and that these species not only do not belong in *Cypella* but cannot be placed in that genus by any key known to me. Of these three species, one appears to be undescribed and the others seem, from their inadequate original descriptions, to have been described as species of *Cypella*. However, since no authentic material of these two is now available to me, and since a photograph of the type of one shows no flowers, I shall, for the moment, make no transfers. The new genus, *Anomalostylus*, will, for the present, be described as a monotype, although ultimately, either by transfers or by the description of further novelties, it will contain three species.

In general appearance, the flower of *Anomalostylus* has a clear similarity to that of *Cypella Herberti* (Lindl.) Herb. The style, however, is so unlike that of *Cypella* that it is difficult to see how these plants could ever have been assigned to that genus. Most of the species in *Cypella* have short or moderately short style-arms with the stamens obviously opposite the style-arms, and the transverse stigmatic areas exceeded by two (in some cases, apparently three) style-crests. In any case, stamen, style-arm, stigma and style-crests lie on the same radius. This is true, too, in such species as *C. linearis* (HBK.) Baker, in which the style-arms are very long, and in *C. Rosei* R. C. Foster, in which the style-arms are obsolete or nearly so. In *Anomalostylus*, on the contrary, while there are two stigmatic tongues above the apex of each stamen, there are no true style-arms, unless the three apical lobes of the style, which are *alternate* with the stamens, be considered as style-arms. The anomalous situation then arises of having stigmas at the base of style-arms, while style-crests are suppressed.

If what is actually meant by the expression "stamens opposite the style-arms" is expanded, this anomaly becomes more apparent than real. In *Iris*, *Cypella*, *Mastigostyla*, *Alophia*, *Tigridia* and *Cardenanthus*, in all of which the stamens can be seen to be opposite the style-arms, there are three visible vascular strands, one in each style-arm (although this sometimes divides above the base). The style of *Anomalostylus* also shows, ultimately, three distinct vascular strands, and these are *opposite* the stamens, just as is true of the other genera mentioned. In other words,

instead of referring to stamens as opposite or alternate with style-arms, we should refer to them as being opposite or alternate with vascular strands. Since the first version refers to a condition far more easily and quickly determinable, I shall, in general, continue to use it. Nevertheless, the use of the second expression as synonymous with it makes possible the retention of *Anomalostylus* where it plainly belongs, in the *Cypella*-complex of genera.

If this interpretation be correct, an explanation of the three apical lobes must be given. From their position, they undoubtedly represent tissue which develops into style-crests in the other genera mentioned. The absence of true style-crests in *Anomalostylus* may be due to fusion of crests or to a suppression of the fissure between adjacent crests. The result would be the same in appearance, probably, in either case. More is involved, however, than fusion or lack of fission; there are further morphological developments which add to the differences between *Cypella* and *Anomalostylus*. At each sinus above the anther-apex, the two short stigmatic tongues can be seen, each showing a densely puberulous-papillate upper surface. This puberulence extends upward as a slight ridge just below the inner edge of the lobe, forming a small open channel from each stigmatic tongue to the retuse apex of each stylar lobe. At each retuse apex there is a ridge extending longitudinally down the inner surface of the style. In one unusually favorable example studied, this ridge seemed to be hollow, containing a channel, like the hollow ridge down the adaxial side of the style-arms in *Iris*. This channel, in *Iris*, is that in which germinated pollen-tubes grow down the style to the ovary.[2] It is possible that a similar function is performed by the ridge in *Anomalostylus*, but this must be considered only a tentative hypothesis until living material can be studied and serial sections made of the style.

Anomalostylus, gen. nov. Planta bulbosa, caulescens; bulbus incomplete notus. Folia basalia plura, rigida, lineari-ensiformia; folia caulina pauca, basi vaginantia. Inflorescentia terminalis, flores longe pedicellati, spathae herbaceae. Flores crateriformes, tepala basi connata sed non in tubum coalita, tepalorum seriei duae dissimilares et inaequales. Filamenta ad basin breve coalita, deinde libera; antherae adaxialiter inter loculos styli alas amplexantes, cum styli lobis apicalibus alternae. Stylus sursum ampliatus, valde trialatus, styli rami veri nulli; styli cristae verae nullae, sed stylus apice in lobis tribus retusis cum antheris alternis terminans; linguae stigmatosae duae supra apices antherarum ad sinus inter styli lobos. Capsula seminaque ignota.

[2] See Sawyer in Bot. Gaz. lxiv. 159–164 (1917).

TYPE-SPECIES: *A. crateriformis.*

ANOMALOSTYLUS **crateriformis,** spec. nov. Bulbus imperfectus, probabiliter magnus (vide *Regnell*, III, no. 1214). Folia basalia plura, ad 80 cm. longa et 1.8 cm. lata, linearia, glabra, acuta, striata, venulis numerosis tenuibus et nervis medianis quam ceteros magne prominentibus; folia caulina 2–4, infimum 12–42 cm. longum, vaginans, superiora in ordine reducta. Caulis 1–3-ramosus, teres, glaber, axis et rami in spathis pluriforibus terminantes. Spathae herbaceae, subnaviculatae, exterior striata, carinata, abrupte acuta, 3.5–4.5 cm. longa, interior sublongior, truncata; pedicelli glabri, anthesin quam spatham interiorem breviores, demum elongati. Ovarium oblongo-clavatum, glabrum, ad 9 mm. longum. Flores verisimiliter lutei; tepala exteriora obovata, ad 3.5 cm. longa et 2.2 cm. lata, sine differentia notabile inter laminam et unguem, pars basalis intus longitudinaliter 8–9-cristata et sparse puberula, apice retusa cum apiculo perbreve obtuso penicillato; tepala interiora ad 2.5 cm. longa et 1 cm. lata, unguis spathulato-naviculatus caeruleo- vel purpureo-suffusus et -striatus, in sicco quam tepala exteriora tenebrior, glanduloso-ciliatus et intus glanduloso-pubescens, erectus vel subpatens, apice subinflexus, lamina perreflexa lutea, basi macula lata pubescente U-formata et mediano maculis 2 orbicularibus vel ovalibus pubescentibus ornata, apice subobtusa et breviter penicillata. Filamenta basin 1 mm. coalita, 5–6 mm. longa; antherae 7–11 mm. longae, apices sub styli sinus 1–2 mm. Stylus paene e basi sursum ampliatus, 1.4–1.5 cm. longus, lobi humiles rotundati vel subdeltoidei retusi 1.5 mm. alti et ad basin 3–4 mm. lati.—BRAZIL: PARANÁ: Serrinha, ad marg. viae ferreae, Oct. 14, 1909, *Dusén*, no. 8705 (TYPE, US; isotype, NY), distrib. as *Cypella* cf. *longifolia;* MINAS GERAES: 1865–66, *Regnell*, III, no. 1214 (US); RIO GRANDE DO SUL: Estancia L. Gomez (Neu-Württemberg), 500 m. alt., Oct. 18, 1904, *Bornmüller*, no. 302 (G), distrib. as *Trimezia martinicensis.* PARAGUAY: in the campo Estancia Primera, January, 1932, *Jörgensen*, no. 4537 in part (as to NY).

It seems strange to me that so widely distributed a plant should have gone undescribed for so long, but I find nothing with which it can certainly be identified. It becomes increasingly strange since two species of this genus were collected over a century ago. They were painted by Larrañaga and are reproduced in his Escritos, Atlas, i. tt. XII and XVIII (1927). Of these, t. XII almost certainly gives a beautifully exact representation of the flower of *A. crateriformis,* with a recognizable but rather crude detail of the style. If Larrañaga's drawing of the bulb is anywhere nearly accurate, the bulb is, as I have suggested, quite large.

GRAY HERBARIUM.

LA TAXONOMIE DOIT-ELLE S'EXPÉRIMENTALISER?

Par Père Louis-Marie, o. c. r.

La science moderne, depuis vingt ans surtout, *équipe* ses chercheurs,—je veux dire, non seulement, qu'elle leur fournit un équipement adéquat mais qu'elle les groupe en équipe, avant de les lancer à la solution des grands problèmes; tel, entre bien d'autres, le centenaire problème de la distinction du genre et de l'espèce, qui faisait déjà gémir le vénérable Thomas à Kempis au XVe siècle, tout comme celui de la distinction des espèces qui invitait les philosophes d'alors à se prendre aux cheveux! Aujourd'hui, la crise des espèces est descendue en sciences expérimentales. "One of the most vexing problems to modern biologists is the species problem," redisent en un lointain écho ceux de l'équipe Clausen-Keck-Hiesey.[1] On espère pourtant parvenir, un jour, à la sérénité des sciences spéculatives. Pour trouver les bases définitives de l'espèce et des autres catégories naturelles de la biosphère, on préconise une méthode "parallaxe," qui appelle à son aide et conjugue les sciences *voisines*. Puisque la vie est à ce point complexe, on se propose prudemment de l'étudier sous ses divers aspects, "from morphological, distributional, ecological, cytological and genetical angles . . ."[1]

Cette coopération des sciences affines, dans un travail de resynthèse nécessaire après tant d'années d'analyse unidisciplinaire ne projetant que d'étroits faisceaux de lumière à travers nos ignorances, s'imposait et il n'est pas surprenant qu'elle rencontre tant de faveur dans les milieux scientifiques. Les sciences biologiques, à leur tour, cessèrent de s'exclure pour s'hybrider bravement à l'exemple de leurs objets dans la nature. De ces relations pratiques, naquit une pléiade de scientistes se *préfixant* de: cyto-, éco-, socio-, mathématico-, chimio-, physico-, etc., pour ne parler que des spécialistes en sciences pures; certaines associations firent fortune, comme celles des phyto-sociologues, des zoo- et phyto-biométriciens, des bio-écologistes, des cyto-généticiens, cyto-géographes et cyto-taxonomistes. Les Experimental Taxonomists s'assurèrent d'un rapide prestige, en adoptant tous ces états et quelques autres, leurs méthodes étant statistiques, autant que faire se peut et un peu plus, expérimentales au sens le plus large, ayant pour objets tout ce qui tombe sous l'observation et l'expérimentation, dont parle Claude

[1] Jens Clausen, David D. Keck and William M. Hiesey. 1935—Annual Report of Plant Biology, Carnegie Institution of Washington, 1934–35, pp. 201–206.

Bernard dans sa classique *Introduction.*[2] Le Field Botanist, l'explorateur herborisant, si bien personnifié par M. L. Fernald, qui s'oppose au compilateur livresque, au remueur d'exsiccata, au systématiste à la portière ou au volant, devait se revêtir de toutes les doublures de la *botanique descriptive:* être, en tout cas, géographe, écologiste (s. l.), phyto-économiste et folkloriste.

En 1927, on recontrait, même à Harvard, des hommes de science d'une certaine éminence, souffrant encore d'un exclusivisme ironiquement extravagant. A un cours de physiologie, très achalandé en première leçon, le professeur avoua, en manière de préface, qu'un étudiant lui ayant demandé, en traversant le campus, jusqu'où s'étendait la Physiologie, il n'avait pas eu à chercher bien loin pour définir l'objet de cette science; il avait tiré de dessous son bras les deux bouquins qui s'y trouvaient fort à point, et de lui en donner les deux titres-limites: "Cela va de la *Structure de l'atome* à l'*Intelligence du singe.*" Seulement cela. Quelques jours plus tard, notre professeur se rendit coupable d'une petitesse à l'égarde de la Taxonomie et de son plus noble outil, l'herbier. Ayant dû rappeler que c'était d'un spécimen de solanacée, tacheté de mosaïque et conservé en herbier depuis de nombreuses années, qu'on venait de transmettre cette maladie à des plantes vivantes, il ne put s'empêcher d'ajouter mi-blaguant mi-sérieux: "Et c'est le seul service que la systématique ait jamais rendu à la science!"—Au reste, cette attitude de blague légèrement méprisante à l'égard de sciences trop ignorées était générale. Que de malices les systématistes ne réservaient-ils pas en retour aux étudiants de la vie en morceaux et en éprouvettes, que sont les physiologistes! que d'accusations contre ces pauvres agronomes qui ne font que répandre les mauvaises herbes avec leurs parcelles expérimentales et leurs semences pures certifiées![3]

[2] Les équipes Babcock-Hall et Clausen-Keck-Hiesey, de la Californie—ajoutons aussi celle de G. L. Stebbins, Jr., un autre ancien élève de Fernald—ont beaucoup fait pour lancer en Amérique la Taxonomie Expérimentale, dont elles définirent les principes et les problèmes, et dont les travaux, consignés surtout dans les Carnegie Inst. Wash. Year Books Nos. 34–35, constituent "a wealth of new information, observational as well as experimental."

[3] La botanique descriptive, en tout cas, savait mettre en relief les insignes services qu'elle avait depuis toujours rendus à la science, à l'industrie et . . . à la politique! Les anciens du cours de "Botany 7" à Harvard, entre les années 1925 et 1930, se souviennent encore du palpitant récit—tous ceux du Professeur M. L. Fernald le sont—de la cession du Labrador et de tout le secteur de l'Ungava, déversant ses eaux dans Hamilton Inlet, à Terreneuve. Dans ce procès international, pour annihiler les prétentions de la Puissance du Canada, on eut recours à une expertise scientifique; or ce fut la Botanique systématique que l'on invita pour faire la preuve favorable, non la physiologie ni la bactériologie! Voici les péripéties du drame mises en scènes à la manière de Fernald.

(*Continued on page* 114.)

Cette jactance et cette partialité enfantine, chez des sciences qui avaient et qui ont encore tant de progrès à faire, ne sont heureusement plus de mise. Une vue plus éclairée de la difficulté de leurs problèmes a forcé les sciences biologiques à se donner la main et à ne mépriser aucun moyen à leur disposition.

Il ne faudrait pourtant pas confondre cette coopération entre les sciences, qui est très désirable, avec un mélange de doctrines mal digérées et d'outils hétéroclites, de forces insuffisamment coordonnées, qui n'est pas désirable du tout. Chaque discipline scientifique doit conserver ses vertus propres et son outillage nécessaire, dans ce travail d'équipe; le grand instrument de la taxonomie est l'herbarium.—Pour L. H. Bailey, "a happy combination of horticulturist and highly competent systematist," l'herbier devra être comme ses syllabus et ses encyclopédies, une collection d'espèces cultivées et de leurs innombrables "formes mineures," jordanons ou mendélions, étiquetées invariablement *variétés*, quand elles ne sont pas nommées par un binôme, ainsi que de vraies espèces.—Pour Edgar Anderson, qui est génético-biométricien—et cela ne le définit que partiellement—la collection de plantes est plus qu'un outil, c'est un laboratoire servant à une foule de sciences.—Un de mes amis, qui a étudié et visité, durant une douzaine d'années, l'Est américain boréal-arctique, s'est mué récemment en un botaniste météorologiste; grâce à d'innombrables coupes en travers les tiges ligneuses de ses récoltes, il espère reconstituer le climat de ces lieux, durant le dernier quart de siècle. Chacun veut être le bienfaiteur, l'ami, l'hôte ou le parasite de l'herbier!

Premier acte:—Le gouvernement de Terreneuve télégraphie à Harvard demandant si on a un expert de la flore du Labrador?—Oui.—Peut-il se rendre immédiatement en la capitale de Terreneuve?—Non, répond Fernald, non sans fièreté. On ne dérange pas ainsi en plein hiver un professeur chargé de leçons et de laboratoires, de travaux de recherches, de la mensuelle Rhodora et de plusieurs autres contributions dont la date de naissance ne pouvait guère tarder. Au reste, avec l'Herbier Gray et sa documentation, il n'est pas nécessaire d'aller à Terreneuve pour savoir ce qui croît au Labrador! (rideau). *Deuxième acte:*—Le Premier-Ministre de Terreneuve s'en vient à Boston et s'installe au luxueux Statler où Fernald va le rejoindre, accompagné peut-être d'un obscur zoologiste . . . Après trois jours de fécondes méditations taxonomiques sur ce problème, avec, sous les yeux, une liste bien faite d'une récolte d'Hamilton Inlet par le jeune R. H. Wetmore, alors systématiste (!), et un autre relevé floristique d'un malheureux paléo-zoologiste qu'on prit en fautes à plus d'un endroit, Fernald remit un volumineux mémoire, plein de l'autorité de la Botanique descriptive à son mieux, appuyant victorieusement les réclamations terreneuviennes. Gras honoraires et remerciements. (rideau). *Troisième acte:*—La Cours suprême de l'Empire britannique, ayant entendu les partis, donna gain de cause à la petite Terreneuve, qui avait eu la sagesse de s'en remettre à la Taxonomie! "Si vous connaissez d'autres pays dont les frontières sont litigieuses," concluait joyeusement le Professeur Fernald, "envoyez-les nous: c'est passionnant et . . . rémunérateur!" (grand rideau—applaudissements).

On prédit pour l'herbier le plus glorieux avenir, s'il veut bien se reconnaître les obligations suivantes:[4]

1. L'Herbarium demeurera une magnifique collection des espèces existantes et les étiquettes de chaque récolte resteront des documents historiques, floristiques, écologiques, géographiques, etc., de toute première valeur.

2. Il doit conserver précieusement les *types*, ces pièces à conviction légitimant la naissance des nouvelles entités et pouvant servir plus tard à prouver leur invalidité. Ce sont parfois des phénotypes géographiquement et morphologiquement extrêmes.

3. Dans l'herbier, doit se trouver toute la gamme des variations somatiques hé éditaires et acquises, constitutives ou plastiques. Oui, si on les rencontre en nature; mais si on les provoque en parcelles?

4. Il doit recevoir toutes les collections massives où se module le dynamisme d'une population, d'un clone, des ramifications d'un rhizome ou d'une souche retigeant plusieurs années consécutives, dans le temps et l'espace. Physiologistes et phyto-sociologistes ont besoin de pareilles données.

5. L'Herbarium de demain devrait aussi encaisser, pour le bénéfice de l'agriculture et de l'horticulture, des séries d'individus homologables, récoltés à des moments précis et permettant de comparer l'efficacité des méthodes culturales, des rotations, des engrais, des herbicides, insecticides et fongicides. Les techniciens de ces cultures scientifiques réclament ces générations de témoins.

6. Les généticiens, travaillant au démêlage des types naturelles et à la recombinaison artificielle de ces mêmes types, désirent placer en herbier les plantes marquant les points de départ et d'arrivée de leurs travaux, ainsi que les progrès intermédiaires, fixant a si les phénotypes de chaque génération: tout cela est capital pour bien comprendre le mécanisme des transmissions héréditaires.

7. De même, les taxonomistes écologistes aimeraient bien garder au sec leurs "transplants" affichant la modifiabilité de leurs caractères distinctifs sous des conditions de milieu différentes, afin de pouvoir comparer plus tard les dérangements enregistrés ainsi dans leurs courbes de croissance.

8. Les cyto-botanistes voudront retrouver en herbier les organes des plantes qui auront servi à l'établissement de leurs nombres chromosomiens spécifiques; on voudra même perpétuer en vie ces types cytologiques. Rien n'empêche évidemment de

[4] F. R. Fosberg,—*The Herbarium.* Scientific Monthly. pp. 429–434, Dec. 1946.

coller sur la feuille d'herbier une enveloppe contenant les lamelles portant ces coupes de mitoses historiques.

9. Les morphologistes et les physiologistes y accumuleront les anomalies et les monstruosités. Les phylogénistes, grâce à elles, tâcheront de répérer les homologies sous les adaptations détraquées et le jeu de l'évolution jusque dans leur lointaine généalogie.

10. Que de services, l'herbarium pourra rendre à l'entomologie et la phyto-pathologie en récoltant, en plus des spécimens en santé, des individus malades, parasités et partiellement dévorés . . .

Malheureusement, quelle Babel ne deviendra pas l'herbier classique, si l'on cède inconsidérément à toutes les demandes de ces dernières-nées de la Botanique, qui découvrent, tout d'un coup, quel trésor est l'herbier avec ses exsiccatae, témoignant de leurs travaux plus fidèlement que la photo, le dessin et l'imprimerie. On peut regrouper sans les confondre plus qu'il ne faut, les collections d'une cité ou d'une université,—comme celles d'Harvard actuellement,—pour des motifs d'utilité, d'économie et de prestige. Mais à pousser trop loin ces concentrations, on se prépare fatalement une crise d'*engorgement*, comme celles qu'on redoute dans certaines bibliothèques multimillionnaires. Au reste, ces grandes centrales universitaires de livres reconnaissent l'existence des bibliothèques départementales, où les spécialistes peuvent trouver rapidement les publications qui les intéressent. Il faut se conduire de la sorte pour le grand Herbarium public, qui doit rester un instrument de la systématique des flores naturelles de la terre; les *artéfacts*, produits en éprouvette, parcelle ou agriculture, méritent d'être conservés, mais dans des herbiers spéciaux et sous une documentation spéciale; sur une étiquette d'herbier cytologique, on ne cherchera pas les mêmes précisions que sur celles d'un herbier de biométriciens ou de génétistes. S'il fallait faire entrer dans nos herbiers classiques tous les jordanons et mendélions, réalisés par hybridation ou autrement en parcelle, et les distinguer d'un nom latin, la liste mondiale des entités reconnues se verrait décupler, passant facilement de 500,000 à plus de cinq millions. Cette constellation de phénotypes, au contraire, fera très bien dans une collection génétique, où on aura des coëfficients spéciaux à inscrire au génotype développé de chaque mutant qui le nommeront mieux pour les initiés que le plus encombrant quadrinôme latin; les herborisants n'ont pas besoin de connaître ces types qu'ils ne rencontreront pas dans la nature. Il faudra donner le même

conseil à toutes les autres phytologies dont les points de vue spéciaux s'éloignent trop de l'étude qualitative des flores normales. Ces sciences sont les bienvenues toutes les fois qu'elles désirent puiser à cette source profonde qu'est l'herbier classique, mais qu'elles se créent des herbiers particuliers pour conserver leurs récoltes très spéciales. Le premier pas en Taxonomie expérimentale est l'étude des spécimens d'herbier, disposés en collection suivant les aires géographiques de leur espèce; les variations qui s'y rencontrent de l'E. à l'O. et du N. au S. se trouvent toutes classées. Eric Hultén s'est surtout appuyé sur des données d'herbiers dans sa grande étude des biota arctiques et boréaux[5]; la loi de Vavilov aurait pu se formuler uniquement en se basant sur le relevé des distributions géographiques mentionnées en herbier.

C'est le seul exclusivisme que doit se permettre la Taxonomie classique pour ne pas perdre tout caractère. Elle ne refuse pas, pour autant, l'aide que lui offrent les autres membres de l'équipe des sciences qui travaillent à asseoir, sur une même base, l'espèce dans la nature et l'espèce d'herbier. La taxonomie expérimentale ne vise pas à décupler le nombre des espèces et des autres entités sous-spécifiques, mais à ne publier la naissance que de celles qui ont vraiment droit de vivre et pouvoir de se maintenir.

On est bien forcé d'admettre que, "dans son acception usuelle, la seule qui soit convenable pour décrire une flore ou classer un herbier, l'espèce n'est qu'un nom sous lequel on trouve des groupements très divers."[6] Le *linnéon*, qui peut être un écotype, un écospecies ou même un coenospecies, se définit par des particularités constantes surtout morphologiques, "dont le nombre est déterminé," écrit encore G. Roberty, "uniquement par le juste souci qu'ont les descripteurs de flore ou les conservateurs d'herbier, d'obtenir des groupements d'amplitude à peu près égale." Ainsi entendu, l'espèce existe surtout, sinon uniquement, dans le cerveau humain. Mais on nie de moins en moins l'existence d'espèces vraies, dans la nature, qui sont des sortes de climax morphologiques dans une mosaïque héréditaire ancestrale, qui se maintiennent aussi longtemps que les gamètes d'un type ne peuvent se féconder qu'entre elles. Le partage cependant est difficile entre ce qui appartient, dans chaque *centre d'équilibre*, à l'hérédité et la nature, d'une part, ou à la nurture et l'ambiance,

[5] Hultén, Eric,—Outline of the history of arctic and boreal biota during the quaternary period.—Stockholm. 1937.

[6] Roberty, Guy, 1946.—Proposition sur la nomenclature des groupements systématiques de rang inférieur à l'espèce. Candollea X: 293–344.

d'autre part. Puis, l'herborisation a ses limites. La récolte sera toujours arrachée de son milieu et rapportée de très loin, parfois; tuée, tronçonnée et fragmentée, écrasée et tant bien que mal séchée, assez décomposée, elle nous parvient avec des caractères incomplets et des titres passablement avariés. Le jugement porté sur son identité sera, de ce chef, toujours faillible et souvent entaché d'erreurs inévitables.

Voici le moment de collaborer et d'emprunter à la cyto-génétique quelques unes de ses méthodes, que les savants russes emploient en génétique végétale appliquée, depuis plus d'un quart de siècle, avec le succès que l'on sait. On en connaît les grandes phases: 1—Détermination des aires géographiques de chaque genre et distribution de toutes les espèces indigènes existantes. 2—Culture en parcelles expérimentales des types récoltés. 3—Hybridation des espèces ou variétés surtout géographiquement distantes. 4—Refonte des "blocs héréditaires." 5—Polyploïdie. 6—Caractères liés au sexe. 7—Mécanisme des mutations. 8—Chimères et "hybrides" de greffe. 9—Effets de l'inogamie et de l'exogamie (heterosis). 10—La caryosystématique. 11—Le problème de l'origine des plantes cultivées. 12—La vernalisation, etc.

C'est en se servant de ces méthodes que la Taxonomie expérimentale s'efforce de définir les espèces, de façon objective.—Pourquoi un prochain Congrès international de Botanique ne promulguerait-il pas une loi décrétant que tout type nouveau, avant d'être officiellement lancé, devra subir un "test de valeur", durant lequel seront établis son caryotype et son génotype, sa formule héréditaire distinctive? Cet examen, impliquant culture pure et croisée en parcelles, reconnaissance du nombre chromosomien et des génomes, en présence, prendra le temps nécessaire, plusieurs années s'il le faut. L'explorateur botanique devra rapporter, de ses herborisations, des spécimens vivants (graines, racines, bulbes, rhizomes, etc.) des types critiques qu'il désire publier comme entités nouvelles; il devra les soumettre à l'organisme (laboratoire ou station expérimentale) accrédité par le Congrès international de Botanique et en attendre le rapport avant d'en faire quoique ce soit de systematiquement nouveau. Cet examen préliminaire officiel devrait être aussi obligatoire à la publication valide d'une espèce que la diagnose latine et la présentation d'une récolte-type. Il serait facile d'intéresser, à la création de cet organisme officiel, quelque société philanthropique. Des équipes particulières de taxonomistes expérimentaux obtiennent déjà des octrois à cette fin.

Il y a encore tellement à faire de ce côté, où la classification moderne trouvera son salut. A peine a-t-on calculé les nombres chromosomiens du sixième des espèces végétales décrites. Le mécanisme de l'hérédité dans les grandes familles (v. g. graminées et cypéracées) à genres et à espèces indigènes nombreux ne sera pas de sitôt élucidé. On se jette plutôt vers les céréales et les plantes ayant fait fortune en industries; on joue avec la vigueur de leurs hybrides. Sur une centaine de références, que j'ai fait relever sans tri par un de mes étudiants, concernant la génétique appliquée des seules graminées, le partage se fit ainsi:

—40%, trauvaux d'hybridation intergénérique et interspécifique.
—95%, travaux sur les céréales (Triticum 37, Hordeum 25, Secale 9, Avena 8, Zea Mais 8, Sorghum 6)
—Dactylis 2, Festuca et Poa 2, Agrostis, Bromus et Phleum 1; Calamagrostis, Trisetum, Danthonia, Deschampsia, etc. 0.

Les petites dimensions des fleurs et la structure compacte de l'épillet de ces graminées indigènes rendront toujours la technique de l'hybridation délicate, de même que le contrôle de la fructification et la récolte par catégories des individus, qui naissent parfois de pseudo-fécondation, par viviparité ou apomyxie: l'ovule bouture, quand ce n'est pas tout l'épillet et ses bractées (*paraxénie*[7]). Cela est plus particulièrement fréquent chez les plantes de la flore arctique ou dans certain genre souffrant de polyploïdie avancée.[8] L'allélomorphie des principaux caractères sur quoi reposent les déterminations génériques et spécifiques est encore bien peu étudiée expérimentalement. Quand saurons-nous, d'expérience, si la pilosité du callus des fleurs chez les Calamagrostis *ancylatherae* obéit à un système d'allèles multiples ou à une interaction poly-génique? Quels rapports exacts existent entre:

1—*Calamagrostis nebula*, avec sa couronne de longues soies isodynames;
2—*C. montanensis*, à couronne dense de soies plus courtes;
3—*C. perplexa* et *C. Fernaldii*, à couronne brisée en 2 grosses touffes latérales;
4—*C. purpurascens* et *C. Lepageana*, dont les touffes latérales sont réunies par un cordon de poils très courts tiré sous la nervure médiane du lemma;

[7] Louis-Marie, R. P.—Problèmes de biologie végétale. 78–81, 1941.
[8] Tinney, Fred W. and O. S. Aamodt—The progeny test as measure of the types of seed-development in Poa pratensis L. Journal of Heredity 31: 456–464. 1940.

5—*C. lacustris* et *C. Porteri*, à touffes de poils plus courts ou plus rares, largement séparées;

6—*C. Pickeringii*, à touffes rudimentaires sur callus glabre.

A défaut d'experimentation, l'observation du comportement de ces caractères importants, qui se retrouvent parfaitement, conservés en herbier, depuis longtemps, permet de reconnaître certaines liaisons relativement solides, v. g., chez *Agropyron*, celle des *Holopyron*, entre rhizome—désarticulation sous glumes de tout l'épillet—anthère 3–6 mm. long. et celle des *Goulardia*, entre rhizome absent—fleurs se désarticulant une à une—anthère 1–3 mm. ±; des allélomorphes à dominant *absolu* ou à dominant relatif (qui se délaie), à récessif longuement aristé et à dominant sans arête; dans *Calamagrostis*, la s.-section des *Orthoatherae*, avec ses longues soies et son arête non tordue peu ou pas genouillée semble bien dominer, héréditairement, sur ces points, et géographiquement, les espèces endémiques ou plus cantonnées des *Ancylatherae*. Mais, partout l'exception se rencontre, prêchant la sagesse aux bâtisseurs de cadres et brisant comme à plaisir ces beaux ensembles des "liaisons", v. g. *Agropyron ungavense*, ce Goulardia à rhizome d'Holopyre; *Calamagrostis nebula*, cette ancylathérée avec les longues soies isodynames de l'autre s.-section, où se trouve le très commun *C. canadensis*, etc.—Dans un grand nombre de cas cependant, avouons-le, la seule observation ne nous dira rien qui vaille et dans tous les cas l'expérimentation s'impose, comme critère additionnel de certitude.

Est-ce à dire qu'il faille abandonner ce qu'il y a de bon, de clair et de reposant dans les méthodes actuelles de la Botanique descriptive, pour se jeter à corps perdu dans les symboles monogrammiques ou algébriques les moins encourageants? G. Roberty, après nous avoir fait l'éloge de la nomenclature symbolique, "qui éliminerait à la fois les dilemmes taxonomiques et synonymiques dont la biologie systématique est empoisonnée", nous en donne les inconvénients. Dans son *Gossypiorum revisionis tentamen* (IV)[9], il mitige immédiatement ce qu'il semblait préconiser quelques pages précédement. Pour bien indiquer la *pesée des caractères* présents, il faudrait décrire ainsi le spécimen

[9] Roberty, Guy, 1946—Candollea X: (339) 345–398. La préface de ce travail remonte à 1938 (Candollea VII: 297–360) et les parties I–III à 1942 (Candollea IX: 19–103). L'exemple que je donne de *G. peruvianum Sprucei copticum* est pris dans le travail précédant ce Tentamen IV et lui servant d'introduction. Dans le traité, à p. 382, Roberty se content de donner: PSoo—Var. *copticum* var. nov.—Mistum subspecierum *Sprucei* Rob. et *peruviani* typici; notatissimos characteres omnes congregatos demonstrans. Cultum in Aegypto. *Typus:* toudri, cult. Giza 1924, Simpson C. 121.

du cotonnier suivant: "*Gossypium peruvianum* (+) *Sprucei* (PSoo) de formule $P_9 + S_{10} + M_3 + V_1$, se rattache à notre variété (PSoo) *copticum*. Sa pureté variétale est de 1/100 $[3 \times 9 + 3 \times 10 + 2(10 - 2) + 2(10 - 1)] = 0{,}91$. Pureté satisfaisante et l'individu sera définitivement classé: *G. peruvianum* Cav. (subsp. *Sprucei* Rob.) var. *copticum* Rob. par le rassembleur que nous sommes; *G. Sprucei copticum*—ou même *G. copticum*—par un diviseur." Cela n'est pas trop cabalistique et peut se comprendre avec un brin de pratique. Sous un coëfficient de pureté variétale moins satisfaisant, le type aurait pu être rangé dans un *Proles coptoides:* c'est l'équivalent de nos *formae*, à laquelle Roberty donnera aussi le nom de *race;* le nom de *race* dans Hultén et autres est donné à la sous-espèce. Lorsqu'on aura standardisé, en Taxonomie, le contenu des cadres, il faudra en faire autant pour leurs noms; ce sera autrement facile!

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SOME METHODS APPLIED TO A STATE FLORA SURVEY

By John M. Fogg, Jr.

For several years, with the assistance of a number of his colleagues and the cooperation of several institutions in the state, the writer has been engaged in a study of the plant life of Pennsylvania with a view to publishing a comprehensive account of its flora. In the course of this work a number of procedures have been devised which, it is thought, may be of interest to botanists in other sections of the country who are devoting their attention to floristic studies of a local or regional character. It is therefore the intention of this article to set forth some of the methods and practices which have been developed in connection with the present study and to call attention to certain criteria which are regarded as indispensable in the preparation of a state flora which should be at once as accurate and detailed as possible and at the same time sufficiently broad in its scope to be of value not only to systematic botanists but to students in allied fields such as forestry, conservation, geology and economic entomology.

Although a number of county and sectional floras have appeared in recent years, there has been no work dealing with the plants of the entire state since the publication of T. C. Porter's *Flora of Pennsylvania* in 1903. There has, however, been a considerable amount of field work in progress throughout the state

and, in addition to the rather considerable amount of material at the University of Pennsylvania, large and important collections are housed in a number of other herbaria, notably the Philadelphia Academy of Natural Sciences, the Carnegie Museum, the Pennsylvania State Museum at Harrisburg, and the Department of Botany at State College. The authorities of all these institutions have kindly placed their collections at our disposal and it is a pleasure to acknowledge here our indebtedness to those who have so graciously participated in this undertaking.

With such a wealth of material available to us, a number of practical problems presented themselves for immediate solution. These were concerned mainly with the preparation, identification, recording, and mapping of the countless thousands of specimens which were to pass through our hands. Since we planned to borrow, for example, all of the Pennsylvania specimens from the Carnegie Museum, it was essential not only that these be carefully verified as to the identification of each individual sheet, but also that the significant information contained on the collector's label should be fully recorded in a form which should be made as permanent as possible. Every botanist who has had occasion to refer to a local or regional flora has experienced the sense of frustration in being unable to locate the basis of citation for a particular species or variety. Mistakes in identification or locality reference are perhaps inevitable in a floristic treatment of any considerable scope. It is, however, highly desirable that there should be some way of tracing such errors back to their source and of securing information concerning the individual specimens from which they arose. A persistent effort has therefore been made in the present work to record in a lasting manner all pertinent data relating to every specimen regarded as worthy of admission to the Flora, so that in years to come it may be possible for a student to relocate and examine any specimen which served as a basis for a citation.

Herbarium Practice. The herbarium of the University of Pennsylvania contains more than 250,000 specimens, of which approximately half were collected in Pennsylvania. All of the sheets of a given species are arranged by state according to the geographic sequence adopted at the Gray Herbarium and, to expedite the present study, all sheets collected within the state of Pennsylvania are contained in green species covers. Within each cover the specimens are arranged by county in a sequence which is geographic rather than alphabetical. In general the

order of counties runs from north to south and east to west across the state. This arrangement of counties, while somewhat inconvenient for those not familiar with the geography of the state, is soon learned by those working with the Flora and has the advantage that it brings together specimens of the same species from the same region. By leafing through a green cover or set of covers, it is possible to see at a glance whether a given species is widely distributed or whether it is restricted to a certain section of the state.

The Record Card. For the purpose of recording in permanent form salient facts concerning the specimens in our own herbarium, as well as those borrowed from other institutions, we have selected a white card 9½ x 14¾ inches, which is composed of 100% rag paper. On its two sides are printed the names of the sixty-seven Pennsylvania counties. The sequence of these counties conforms to the arrangement of the specimens in the herbarium. That is, the first county on the front side of the card is Wayne, since that county occupies the northeastern corner of the state. The last county on the reverse side is Greene, which is located in the southeastern corner. Here again with a little use one becomes familiar with the geographic sequence and as data gleaned from the collections are filled in on the card, it becomes possible at a glance to determine whether a given species is uniformly distributed throughout the state or is restricted to a certain section or tier of counties.

Recording. It goes without saying that the real and lasting value of any floristic work depends upon critical determination of the taxonomic entities involved. Granted that the specimens of a given species have been carefully studied and correctly identified, the next step is that of entering on the appropriate record card the significant information given by the collector on his label. This information falls into the following four categories:

1) The exact locality at which the specimen was collected.
2) The name of the collector.
3) The collector's serial number, or, if this does not appear on the label, the date on which the specimen was collected.
4) The source of the specimen; that is, the herbarium or herbaria in which the specimen or specimens of a given number are known to be deposited.

It would be impossible to overemphasize the need for accurate information concerning the localities at which plants are collected.

It is well known that many botanists, especially those of the last century, were content to place on their labels only the most general statements concerning their collecting grounds. We frequently encounter specimens on which the only mention of locality is the name of a county. Many others bear on their labels some such legend as "along Loyalsock Creek," "Pocono Plateau," or "Blue Mts." In a detailed compilation it is obviously better to disregard such specimens altogether than to attempt to guess at their place of origin and thus to perpetuate an ambiguity which may lead to erroneous conclusions. In an age when we are sharpening our focus in an attempt to ascertain those factors which determine the distribution of a given species, the inclusion of inaccurate locality data may completely obscure this relationship.

Those of us who are intimately connected with the present study have learned to depend entirely upon the topographic quadrangles of the U. S. Geological Survey. Working in the field with these sheets, it is usually possible to ascertain one's location within a few yards and to record, at least to a tenth of a mile, the distance and direction from the nearest permanent settlement (village, town, city) in the same county. In the case, therefore, of two collections from approximately the same locality we invariably select for recording the plant collected by the man who is known to be painstakingly accurate in his effort to designate the spots which he visits.

The use of a collector's serial number has become such a standard practice that again in the case of the same species collected from a given locality, preference in recording is given to that sheet which bears such a number. There are several reasons for this, chief among which is the fact that the specimen bearing a serial number possesses for all time a more positive individual identity than one which merely bears a date.

The last information to be entered on the card in each entry is a symbol indicating the location of the specimen or specimens examined. Thus the letter "P" indicates that the specimen is in the University of Pennsylvania Herbarium; "A" indicates the Philadelphia Academy of Natural Sciences; "H" the State Museum at Harrisburg; "S" the herbarium of State College; and "C" the Carnegie Museum at Pittsburgh. In many cases duplicates of the same number are in two or more of these herbaria and this information is conveyed by use of the appropriate symbols. This device has already proved immensely useful in

enabling us to borrow again such sheets as we wished to restudy, for obviously the appearance of a revision of a genus or species frequently requires the reëxamination of material already recorded and mapped. It should prove increasingly useful in future years if the present work is ever revised and it becomes imperative to determine the actual location of the specimens used as a basis for citation in our study.

After a series of specimens of a given species has been carefully checked as to identification and geographic data, the information is then ready to be entered on the record card referred to above. Because of the size and stiffness of the record cards it was early deemed inadvisable to run them through the roller of an ordinary typewriter. This is especially true since new records are constantly being added to the cards. We therefore utilize an Elliott-Fisher flat-bed typewriter in which the card lies flat and the machine moves back and forth across its surface. An experienced operator soon learns to insert under the appropriate county the desired information concerning each specimen which has been approved for recording. Care has been taken to secure a carbon base silk ribbon, thus insuring to the highest attainable degree a permanent record.

There is a space in the upper left-hand corner on the front of the card for the name of the species or variety and the citation of authorship. Under each county it is possible to record the information concerning six specimens belonging to that species. Since we are engaged in studying material from five herbaria, it frequently happens that we ultimately see more than six sheets of a given species from the same county. In this case we use a second or even a third card for this species even though the spaces under all of the counties on the first card may not be filled. It is important to note, however, that when it comes to placing these records on the maps in the form of dots, we restrict ourselves, for the present at least, to only six localities in a single county. To add to the map all of the locations of a certain species from a well collected county such as Bucks or Schuylkill would give a totally false impression of the abundance of that species through its area of occurrence.

As each sheet is recorded it is marked with a rubber stamp which reads, "Recorded U. of Pa. Catalogue of Pa. Plants." This statement is placed just above the collector's label in the lower right-hand corner of the specimen. Here again we use a stamp pad with a carbon base ink to insure a lasting impression.

Since not all specimens of a given species are deemed worthy of recording, the placing of this statement on these sheets which are utilized will enormously facilitate the ease with which the basis of any record may be relocated in the future. Many times in working over the records utilized by Porter in his Flora have we wished that there were some means of knowing just which specimens he had before him as he compiled his list of occurrences by counties.

CHAMAEDAPHNE CALYCULATA (L.) MOENCH

Wayne
GOULDSBORO, 2 MI NE; ADAMS 3700 P
ORSON, 1 MI W; FOGG 10945 P
WAYMART; JENNINGS & GRESS AU 23 20 P
LK. COMO, 4 MI S; GLOWENKE 1616 P
WHITE OAK POND; GRESS&JENNINGS AU 24 20 C
LAKEWOOD; DIX 429 P
Susquehanna
ARARAT, ½ MI E; GLOWENKE 132 P
THOMPSON, 3½ MI SE; FENDER 1878 P
DIMOCK; BROWN JE 1907 A

Lackawanna
MADISONVILLE, ¾ MI NW; GLOWENKE 46 P
MOOSIC LAKE; GLOWENKE 1138 P
VIC. OF SCRANTON; JENNINGS AU 26 20 C

Fig. 1. Reproduction of upper left-hand corner of record card for *Chamaedaphne calyculata*.

As an example of the manner in which information is recorded we have selected the Number 1 card of *Chamaedaphne calyculata* (L.) Moench, a bog species characteristic of those counties lying north of the glacial moraines. Figure 1 is a reproduction of the upper left-hand corner of this card; it illustrates the kind of impression made by the typing machine as well as the manner in which the essential data concerning each specimen are arranged and recorded under the first three counties. It will be noted that the name of the locality appears first and is followed by the distance and direction from it of the spot at which the specimen was found. If, in future distribution of my duplicates, I were to send specimens of my Orson collection (Fogg no. 10945) to Harrisburg and the Carnegie Museum, the letters "H" and "C"

would be added to the "P" to show that duplicates might be seen in those two institutions.

The significant features of the recording procedure just described are that it permits the accumulation on a single set of cards of important facts concerning approximately 2,500 species and varieties of higher plants known to occur within the boundaries of the state, and at the same time enables present and future students to ascertain how each specimen admitted to the list can be relocated. Also, the data contained on the card or cards of an individual species enable us to place corresponding dots on an accompanying outline map of the state. Since it is intended in the final work to include a range map for each species, some explanation concerning the type of map and the technique of entering the dots is in order.

The Map. During the course of our studies we have prepared an outline map of the state of Pennsylvania (See Figure 3) on which appear: 1) The lines of latitude and longitude, 2) The counties, 3) The principal rivers and their tributaries, 4) The southern boundary within the state of the Wisconsin Glaciation, 5) The southern boundary of the Jerseyan Glaciation, 6) The Appalachian Plateau Front, 7) The Blue Mountain Front, 8) The Fall Line. It therefore shows certain physical features which influence the occurrence of many species of plants within the state. For example, certain species occur only north of the Wisconsin Moraine in the northeastern and northwestern corners of the state; others are most abundant in the Valley and Ridge Province which lies between the two mountain fronts; while still others are restricted to the low-lying ground along the Delaware River east of the Fall Line.

The map is printed on a card of the same size and material as that used for the records and for every species in the file there is an accompanying map on which the entries on the record card are represented by carefully placed dots.

Mapping. The task of locating on the outline map the dots corresponding to each entry on the record card is regarded as one of the most significant phases of our entire undertaking, second in importance only to accurate identification of the plants themselves. In our efforts to insure the highest degree of accuracy in the placing of the dots, two methods have been developed which possess sufficient merit to warrant attention here.

In the early years of the project, when it was necessary to locate many thousands of dots as quickly as possible, we pre-

pared a set of transparent overlay maps on which appear the names of the towns, villages, etc., at which specimens have been collected. At the exact spot where the town is located a small hole is drilled through the cellophane. It is thus possible, by placing the transparent map directly over the outline map, to make a pencil mark at the proper place. If the specimen was collected at some distance from a given town, the mapper uses a perforated transparent templet which is ruled with lines to show the compass points and with concentric circles which are a mile apart on the scale of the outline map. Wherever a direction line intersects a circle there is a small hole which permits the placing of a dot at the exact spot where the specimen was collected.

The second method involves the use of latitude and longitude in identifying localities and required the preparation of a card catalogue of all the localities in the state from which collections have been seen and to which new cards are added as new stations come to our attention. Each card bears the name of a town or locality and an exact statement of its latitude and longitude as determined from the topographic quadrangle. In this way it is possible to have in the file not only the names of cities, towns and villages, but also such localities as Pymatuning Swamp, Bear Meadows, Tannersville Bog and other favorite collecting grounds. A sample taken at random from the 8,000 cards in the file will serve as an illustration:

Sinnemahoning 40° 19′ 78° 05′
(also Sinnamahoning)
CAMERON Driftwood (N3)

"Cameron" is the name of the county in which Sinnemahoning is located. "Driftwood" is the name of the topographic sheet, of which "N3" is the symbol which enables us to locate it quickly. Since the main parallels and meridians appear on the map and since the four margins are marked off in minutes of latitude and longitude, it is a simple matter with the use of a scale or protractor to locate any point for which reference data are given. The small templet described above may then be used to locate a spot some distance removed from a fixed point.

My colleague, Dr. E. T. Wherry, in addition to undertaking the treatment of several plant groups of which he has special knowledge, has taken over the task of verifying all geographic data used in the Flora. He has spent many hours checking obscure references and is largely responsible for the compilation of the index of localities.

As each locality is found and dotted in on the map, a short dash (about ¼ inch in length) is made in blue pencil beside the entry on the record card. Occasionally it happens that we are unable to locate a station given by the collector. In that case a zero instead of a line is placed beside that entry on the card, indicating that there is no corresponding dot on the map. If,

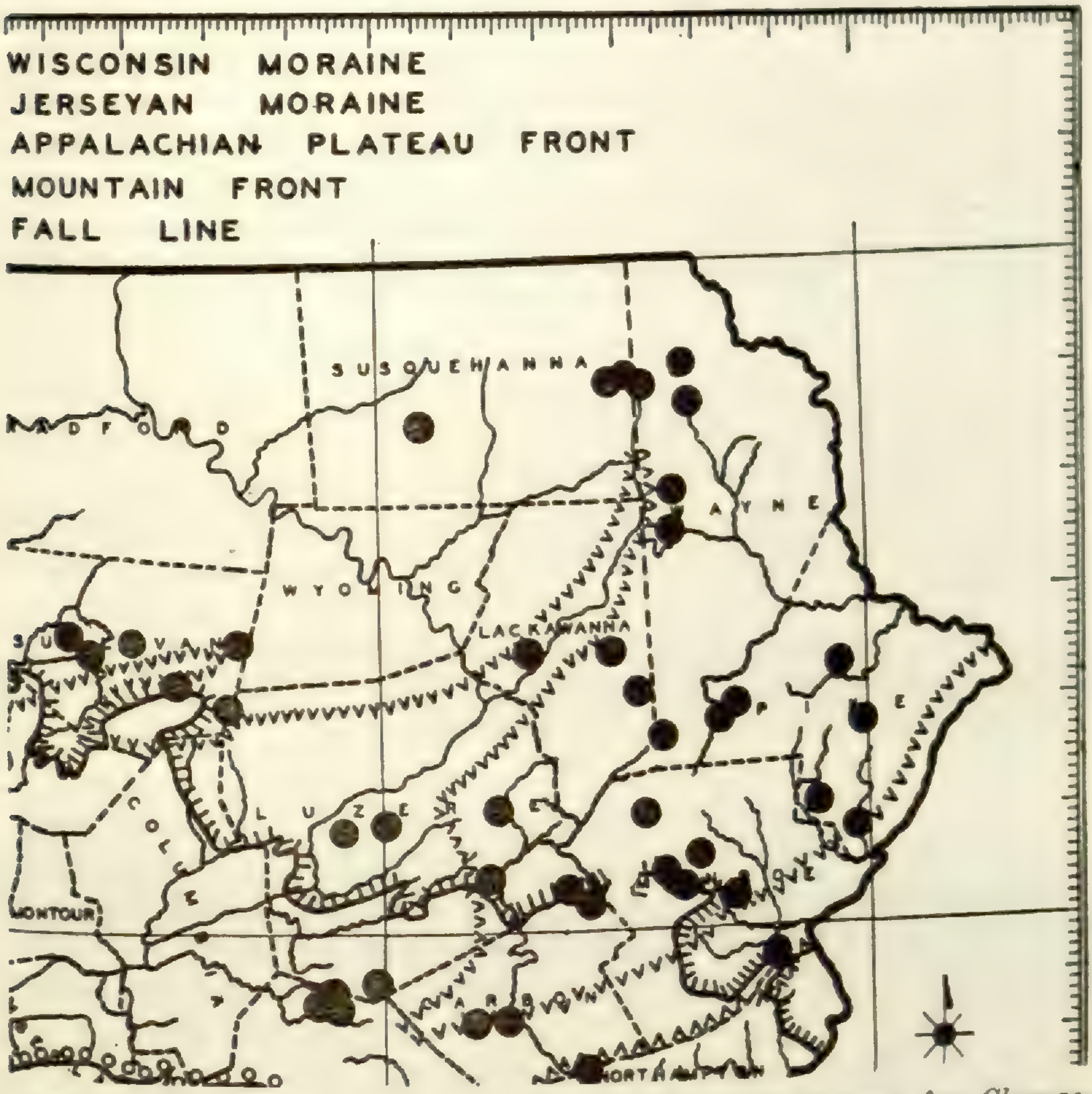

Fig. 2. Reproduction of upper right-hand corner of map for *Chamaedaphne calyculata*.

however, there are localities under that particular county on the second card of that species, one of these will be selected as the basis for a dot, thus insuring the maximum number of six dots per county on the map.

A blue pencil mark for these symbols was selected because such marks will not show when the cards are photographed (Witness Fig. 1, in which these symbols are indistinguishable). If it ever becomes desirable to have the entire series of cards photographed

on microfilm, they will therefore not be marred by signs which are of interest primarily to the mapper.

After all of the entries on a given record card have been entered on the map in the form of small, carefully placed penciled dots, these dots are then ready to be inked in. This is done by means of a small drawing compass or bow pen of the sort used in mechanical drawing. The drawing point is filled with India ink and the fixed tip of the compass is placed on the penciled dot. A circle one-eighth of an inch in diameter is then described. At a later operation these circles are filled in with India ink, making solid circular black dots. It may, of course, be objected that on the scale of the map each circle is approximately three miles in diameter. The important consideration, however, is that the center of the circle is the point at which the specimen was collected and that in the case of a species which follows some physiographic feature, such as the Fall Line or a terminal moraine, it is possible to see whether the plant occurred to one side or the other or was located directly on this particular line.

Figure 2 shows a portion of the outline map of *Chamaedaphne calyculata* on which the localities listed on Figure 1, plus those from adjoining counties, appear as dots. Such a map may be reduced to one by three inches, the size proposed for the Flora, and still preserve its salient features.

One of the most valuable features of a local or regional flora should reside in the emphasis which is placed on the correlation between a species and its environment. Many of the authors of our older floras were content with merely listing the localities or counties in which a species was known to occur. In the present work it is planned to interpret distributional peculiarities, when they exist, in the light of such determining factors as may be recognized, whether these be climatic, physiographic or edaphic. In our attempt to gain some insight into the factors which determine the occurrence of a given species within the boundaries of the state, we have prepared a set of transparent maps, made from the same plate as the master map, on which are shown such features as (1) the various types of soils or rock outcroppings, (2) data concerning mean annual temperature, (3) data concerning annual rainfall, (4) physiographic features, etc. Although many plants are so tolerant of a wide variety of soil and climatic factors that they occur uniformly distributed throughout the state, certain other species thrive only when a given condition or set of conditions is provided. Figure 3 shows the known

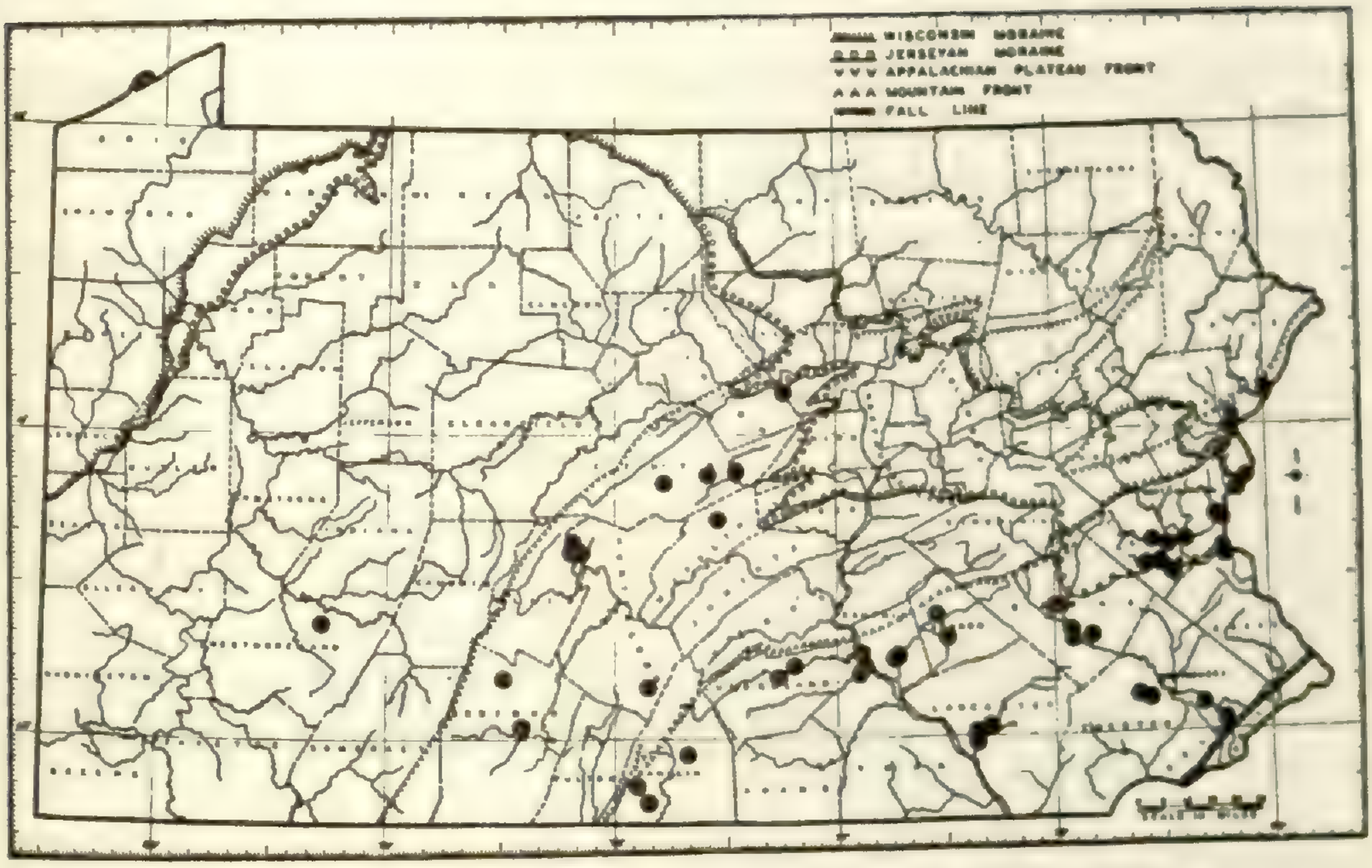

Fig. 3. Range of *Asplenium cryptolepis* in Pennsylvania.

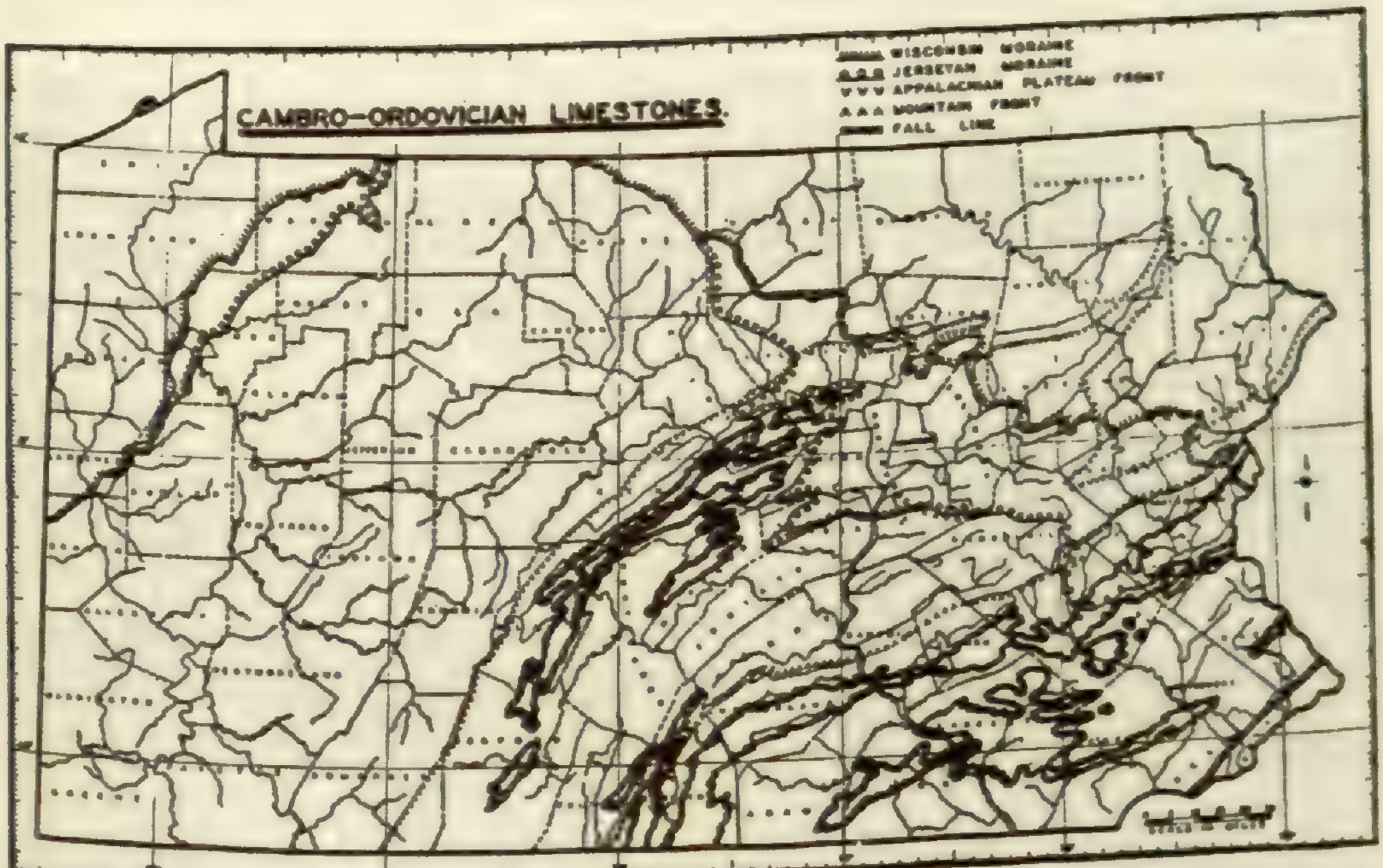

Fig. 4. Outline map of Pennsylvania with overlaid transparent map showing the occurrence of the Cambro-Ordovician limestone.

occurrence within Pennsylvania of the Wall-rue Spleenwort (*Asplenium cryptolepis* Fernald). This is, of course, an obvious example of a species which occurs only on calcareous soils or outcroppings, but this relationship is made more spectacular when a transparent map (Figure 4) showing the occurrence of the Cambro-Ordovician limestone is placed over the distribution map of the species. It then becomes obvious that, with the exception of a few minor limestone outcroppings too small to appear on a map of this scale, every dot conforms to the distribution of limestone shown on the transparency. This simple illustration will serve to demonstrate the usefulness of a procedure which may be employed in a great variety of ways to determine those causes underlying the distributional peculiarities of many species of plants.

It is our intention to incorporate into the survey not only information concerning the distributional vagaries of the plants of the state, but also data concerning what, for want of a better name, may be called the "biology" of the species. Considerable information derived from such closely allied fields as genetics, cytology and plant pathology is becoming increasingly of interest to the student of taxonomy and plant geography and should, we feel, find its way into regional flora studies. As a single example of such observations may be cited the light which has been shed on problems of a distributional nature by recent researches on polyploidy.

Finally, it may be of interest to observe that during the course of these studies analytical keys have been prepared for practically all genera included in the Flora. These keys have been duplicated and placed in the hands of my students for daily use in classroom and herbarium. In this way many shortcomings have been detected and many valuable suggestions made for improving their working value, so that when they appear in print they will at least possess the advantage of having been tested.

Very special acknowledgment is here made to Dr. J. R. Schramm, Chairman of the Department of Botany, who in the early years of the project was instrumental in securing the services of a large group of W. P. A. workers who mounted many thousands of sheets and carried on the routine task of recording and mapping nearly a quarter of a million specimens. It was due to Dr. Schramm's ingenuity and inventiveness that several of the methods herein described were developed.

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GENERIC REVISIONS IN THE CRUCIFERAE: SIBARA

By Reed C. Rollins

Sibara is a relatively small genus of North American Cruciferae. Most of the species are restricted in distribution, often to inaccessible areas of the southwestern deserts of the continent. As a result of their inaccessibility, several members of the genus are very poorly represented in herbaria. Attempts to assess the extent of natural variation in such species are frustrating and often futile. The most widespread species, *S. virginica*, extends from Virginia westward to central and southern California. Probably the most restricted species is *S. filifolia* which has been collected only on Santa Cruz Island, California.

The species of *Sibara* are all annual or biennial herbs. Some of them, at least, go through their life cycle very quickly. Plants of several species have been grown from seed to maturity in less than three months. *Sibara* is undoubtedly related to *Arabis* from which it was initially separated by Greene.[1] In a previous paper[2] presenting a study of *Arabis*, I have stressed the important differences and similarities of these two genera. In the aggregate, the characters pointed to there set *Sibara* apart as a separate assemblage of species from *Arabis* proper. Whether this group of species, which appears to be intrarelated, should receive generic rank or be placed in *Arabis* as a subgenus was difficult to decide. However, after repeated study of the problem, I am still convinced that phylogeny in the Cruciferae as a whole is best served by keeping *Sibara* separate as a genus, even though it is not as discrete as one would like to have it. By so doing one rightly casts doubt upon any suggestions of there being close genetical relationship between the species of the two genera.

There are two seemingly intrarelated groups of species in *Sibara*. Those species with winged seeds and runcinately divided leaves appear to be more closely related to each other than to members of the other group. The species having the above characteristics are *S. virginica*, *S. mexicana*, *S. runcinata* and *S. Viereckii*. The center of the distributional area of this group of species is northeastern Mexico and adjacent Texas. The second group of species includes the rest of those in the genus. The species of this group have wingless seeds and pectinate foliage. Their distributional center is in Baja California, Mexico.

[1] Pittonia 3: 10–12. 1896.
[2] Rhodora 43: 292–293. 1941.

Only two species of *Sibara* have been examined for chromosome number, *S. deserti* and *S. Viereckii*. The chromosomes in root-tip smears are very minute in both species and appear to be fairly uniform in size. *S. deserti*[3] has 2n = 26; *S. Viereckii*, 2n = 28.

Material upon which the present paper is based has been provided by many herbaria. Specimens are cited in accordance with the usual custom of using capital letters as symbols representing the institutions to which they belong. Cooperation has been received from the following herbaria: California Academy of Sciences (CAS); Natural History Chicago Museum (CM); Dudley Herbarium of Stanford University (DS); Gray Herbarium of Harvard University (G); Missouri Botanical Garden (M); New York Botanical Garden (NY); Pomona College (P); Rocky Mountain Herbarium of the University of Wyoming (RM); University of California (UC); United States National Herbarium (US).

SIBARA Greene, Pittonia **3:** 10. (1896).

Annual or biennial, herbaceous; stems single to several from the base, divaricately branched, glabrous or sparsely pubescent below with simple or branched trichomes; leaves pectinate to runcinate-pinnatifid, the upper cauline rarely almost entire, glaucous; inflorescence racemose, lax; flowers small; sepals narrowly ovate to nearly oblong, nonsaccate or the outer pair slightly saccate; petals white to pink or purplish, spatulate to nearly oblong, entire to rarely denticulate at base (constricted in middle in *S. pectinata*); nectar glands small, subtending or surrounding single stamen, absent or obsolete near paired stamens and petals; pedicels not expanded at apex; siliques linear, flattened parallel to septum to nearly terete; valves nerveless to nerved below; seeds oblong to nearly orbicular, winged or wingless, uniseriate; cotyledons accumbent to incumbent. TYPE-SPECIES—*S. angelorum* (S. Wats.) Greene.

ARTIFICIAL KEY TO THE SPECIES

A. Seeds winged; foliage runcinate-pinnatifid, leaf-lobes oblong to obovate; siliques divaricate . . . . . B.
  B. Cauline leaves not auriculate; styles less than 1 mm. long on mature siliques . . . . . C.
    C. Mature siliques 1.5–2 mm. wide; seeds 1–1.5 mm. broad; stems hirsute at least below . . . . . 1. *S. virginica.*
    C. Mature siliques about 1 mm. wide; seeds small, about 0.5 mm. broad; whole plant glabrous . . . . . 2. *S. mexicana.*
  B. Cauline leaves auriculate; styles 2–4 mm. long . . . . . D.
    D. Cauline leaves sagittate, lobed to deeply lobed but scarcely pinnatifid; auricles large, 3–5 mm. long; siliques stipitate . . . . . E.

[3] I wish to thank Miss Mary E. Riner for making this determination on this species.

E. Petals 3–5 mm. long; siliques 1.5–2.5 cm. long. 3. *S. Viereckii.*
E. Petals 6–8 mm. long; siliques 3–5 cm. long. 3a. *S. Viereckii*, var. *Endlichii.*
D. Cauline leaves nonsagittate or only barely so, pinnatifid; auricles small, 1–2 mm. long; siliques nearly sessile 4. *S. runcinata.*
A. Seeds wingless; foliage pectinate; leaf-lobes narrowly linear (except to some extent in *S. deserti* and *S. rosulata*); siliques divaricate, spreading or reflexed.....F.
F. Mature siliques divaricately ascending to widely spreading, 2–5 cm. long (rarely 1.5 cm.); styles slender (except in *S. rosulata* where they are thicker and club-shaped).....G.
G. Siliques widely spreading, nearly arcuate, 1.5–2 mm. wide .....H.
H. Petals entire; siliques arcuate to pendent; leaf-segments 0.75–1.5 mm. wide..... 7. *S. angelorum.*
H. Petals markedly constricted near the middle; siliques widely spreading, scarcely arcuate; leaf-segments narrower..... 6. *S. pectinata.*
G. Siliques divaricately ascending, straight, less than 1.5 mm. wide.....J.
J. Pedicels 6–12 mm. long; basal leaves caducous; styles unexpanded toward the apex..... 5. *S. filifolia.*
J. Pedicels 2–3 mm. long; basal leaves persistent; styles expanded toward the apex.....10. *S. rosulata.*
F. Mature siliques pendulous to reflexed, less than 2 cm. long; styles thick (not markedly so in *S. deserti*).....K.
K. Pedicels less than 4 mm. long; styles club-shaped and expanded near the apex.....L.
L. Siliques flattened parallel to septum, sparsely pubescent; pedicels slender; leaves and stems sparsely pubescent; plants of the Death Valley region of California and Nevada..... 9. *S. deserti.*
L. Siliques terete, glabrous; pedicels thick, approaching siliques in diameter; leaves and stems glabrous; plants of Baja California, Mexico.....11. *S. Brandegeana.*
K. Pedicels 5–10 mm. long; styles narrowing from base to apex..... 8. *S. laxa.*

1. S. VIRGINICA (L.) Rollins. Annual or biennial; stems one to several, decumbent to ascending, branched above, hirsute below with simple or rarely forked trichomes, glabrous to sparsely pubescent.—Rhodora **43:** 481 (1941); *Cardamine virginica* L. Sp. Pl. 656 (1753); *Arabis virginica* Poir. Encycl. Suppl. **1:** 413 (1810); *Cardamine ludoviciana* Hook. Journ. Bot. **1:** 191 (1834); *Arabis ludoviciana* C. A. Mey. in Fisch. & Mey. Ind. Sem. Hort. Petrop. **9:** 60 (1843); *Planodes virginicum* Greene, Leaflets Bot. Obs. **2:** 221. (1912).

A complete description with citation of specimens has been given by Hopkins[4] under *Arabis virginica* (L.) Poir., and need not be repeated here. Most of the specimens cited by him in this work have been verified as to identity by personal examination.

[4] Rhodora **39:** 80–84. (1937).

Several attempts have been made to count the chromosomes of *Sibara virginica*, but they were found to be so minute that the technical difficulties preventing accurate observations were never mastered. In growing *S. virginica* for this purpose, along with a number of *Arabis* species and other crucifers, one could not but be impressed by the great difference in appearance and behavior exhibited by the young seedlings and rosettes of *Arabis* and those of *S. virginica*. To say that they were utterly different is to put it mildly. The young rosette of *S. virginica* resembled that of some species of *Lepidium* far more than any species of *Arabis*, even *A. lyrata* its supposed near relative.

2. S. MEXICANA (S. Wats.) Rollins. Slender annual or biennial, glabrous; stems weak, decumbent, branched above, about 2 or 3 dm. high; basal leaves and lower parts of plant unknown; cauline leaves petiolate, lyrately pinnatifid with entire or toothed segments, 3–4 cm. long, glabrous; inflorescence racemose, elongated in fruit; flowers minute; sepals glabrous, oblong, nonsaccate; petals white, narrowly oblong, 1–2 mm. long; pedicels slender, divaricate, unexpanded at apex, 2–3 mm. long; siliques ascending, only slightly flattened parallel to septum, 12–18 mm. long, slightly more than 1 mm. wide, valves very faintly nerved below or nerveless; style slightly less than 1 mm. long, slender; seeds orbicular, fairly plump, narrowly winged, less than 1 mm. broad; cotyledons accumbent.—Rhodora **43:** 480 (1941); *Arabis mexicana* S. Wats. Proc. Amer. Acad. **17:** 319 (1882).—MEXICO: Guanajuato, 1880, *A. Dugès* (M, TYPE).

S. mexicana is known only from the type collection. That this species is perfectly distinct from all other known species can hardly be challenged, but further knowledge concerning it awaits exploration in the area where it is found. *S. mexicana* is nearest related to *S. virginica*, having similar siliques, seeds, flowers and foliage.

3. S. VIERECKII (Schulz) Rollins. One- or usually several-stemmed annual or biennial, branched above; stems hirsute below with simple trichomes, glabrous above, 1.5–6 dm. high; basal leaves runcinate-pinnatifid, with acutely lobed divisions, sparsely pubescent with simple trichomes, petiolate, 4–10 cm. long; cauline sessile, auriculate, clasping, deeply and irregularly lobed but hardly pinnatifid except the lowermost, sparsely pubescent to glabrous, upper rarely almost entire; inflorescence greatly elongated in fruit, loosely racemose; sepals sparsely pilose to glabrous, oblong to slightly broader, about 2.5 mm. long; petals spatulate, slender-clawed, white, 3.5–4.5 mm. long; pedicels divaricate, pilose to rarely glabrous, unexpanded at apex, 4–8 mm. long; siliques glabrous, divaricate, 1.5–4.5 cm. long, 1.5–2 mm. wide, nerveless to faintly nerved below, slightly stipitate; style 2–4 mm. long; seeds oblong, narrowly winged, about 2 mm. long, 1.5 mm. wide; cotyledons accumbent.—

Rhodora **43:** 481 (1941); *Arabis Viereckii* O. E. Schulz, Notizblatt **11:** 398 (1932).—TEXAS: Laredo, Feb. 1919, *Hanson 348* (G, US); Combe Station, Cameron County, March, 1926, *Runyon 33* (G, US); woodland N. E. of Resaca Park, Brownsville, Cameron County, March, 1944, *Runyon 3778* (DS); Raymondsville, March, 1925, *Runyon 702* (US); Barreda, Cameron County, Feb. 1933, *Runyon 1459* (US); April, 1941, *Runyon 2522* (DS); 2 miles south of Barreda, Cameron County, March, 1944, *Runyon 3977* (DS); Donna, Hidalgo County, Feb. 1924, *Runyon 611* (US); 1 mile east of Sullivan City, Hidalgo County, March 31, 1941, *C. L. & A. A. Lundell 9818* (DS); ca. 8 miles east of Rio Grande City, Starr County, April 5, 1941, *C. L. & A. A. Lundell 9989* (DS). MEXICO: NUEVO LEÓN: Hacienda el Carrizo, Feb. 1906, *Pringle 10207* (G, NY, US).

3a. S. VIERECKII var. ENDLICHII (Schulz) Rollins, Rhodora **43:** 479 (1941); *Arabis Endlichii* O. E. Schulz, Notizblatt **11:** 390 (1932).—MEXICO: Sierra de Parras, Coahuila, March, 1905, *Purpus 1028* (CM, G).

S. Viereckii is a close relative of *S. runcinata*, differing from it only in having sessile, sagittate, auriculate and sometimes nearly entire cauline leaves. In *S. runcinata* the cauline leaves are pinnately dissected and the auricles are much smaller. Both species are known only limitedly from Texas and Mexico, hence an adequate statement of their complete range variation is impossible at this time. Being rapid growing annuals, they show marked responses to environmental influences. Plants which grew under unfavorable conditions are much dwarfed in size when compared to those grown under favorable circumstances.

A number of plants of typical *S. Viereckii* have been grown from seeds supplied by Mr. Robert Runyon of Brownsville, Texas, his number 3778. Root-tip preparations of several of these plants were studied to determine the chromosome number present. The chromosomes were found to be very small, but could be readily counted after the root-tips were prefixed in paradichlorobenzene. The number $2n = 28$ was repeatedly observed.

4. S. RUNCINATA (S. Wats.) Rollins. Annual or biennial; stems one or few, branched or rarely simple, densely hirsute below with rather long white simple trichomes, glabrous above, 1.5–5 dm. high; basal leaves runcinate-pinnatifid, petiolate, pubescent with simple acerose trichomes, 4–12 cm. long, 1–2 cm. wide; cauline similar but with small auricles clasping the stem; inflorescence loosely racemose; flowers small; sepals pubescent, oblong, scarious-margined, nonsaccate, about 3 mm. long; petals white to pinkish, spatulate, 4–5 mm. long; pedicels divaricate to widely spreading, pubescent, remote, unexpanded at apex, 3–8 mm. long; siliques flattened parallel to septum, slightly stipitate, 1.5–4 cm. long, 2–3 mm. wide, nerveless or faintly nerved below; style 2–4 mm. long, slender;

seeds broadly oblong, winged, 2–3 mm. long, 1.5–2 mm. broad; cotyledons accumbent.—Rhodora **43:** 481 (1941).

KEY TO THE VARIETIES

Siliques 2.5–4 cm. long, styles 3–4 mm. long; seeds narrowly winged ..... 4a. var. *typica.*
Siliques 1.5–2.5 cm. long, styles about 2 mm. long; seeds more widely winged ..... 4b. var. *brachycarpa.*

4a. Var. **typica.** *Arabis runcinata* S. Wats. Proc. Amer. Acad. **17:** 319 (1882), not *A. runcinata* Lam. Encycl. **1:** 222 (1783).—MEXICO: near San Luis Potosí, 1876, *J. G. Schaffner 155* (G, TYPE); near Tehuacan, state of Puebla, Dec. 1895, *Pringle 6292* (G, NY, US).

4b. Var. **brachycarpa,** var. nov. Herba annua; siliquis 1.5–2.5 cm. longis; stylo ca. 2 mm. longo; seminibus alatis.—TEXAS: Cotulla, La Salle County, March, 1917, *E. J. Palmer 11314* (RM, TYPE); Laredo, March, 1907, *Reverchon 3715* (M); Laredo, 1932, *M. E. Jones s. n.* (G).

Var. *typica* is a larger plant throughout except it is usually not taller. Its leaves, stems and siliques particularly are larger than those of var. *brachycarpa.* The two entities are also widely separated geographically insofar as our present knowledge of the species is concerned. Further exploration of the region adjoining the known stations for these plants should bring the ranges of the varieties closer together.

The leaves and habit of *S. runcinata* resemble certain species of *Sisymbrium,* but the winged seeds, accumbent cotyledons, flattened siliques and unexpanded pedicels certainly ally it with *S. virginica.* Actually the closest relative of *S. runcinata* is *S. Viereckii,* but both species belong in the same group as *S. virginica* and *S. mexicana.*

5. S. FILIFOLIA Greene. Single-stemmed annual, slender, glabrous and glaucous, branched above, 1.5–3 dm. high; basal leaves absent or caducous; cauline pinnate with narrowly linear segments, 2–4 cm. long, petiolate, segments 5–10 mm. long; inflorescence loosely racemose, rachis somewhat gyrate; sepals oblong, glabrous, scarious-margined; petals spatulate, broadening from base to apex, pink to purplish, 3–5 mm. long, entire; pedicels slender, divaricate, 6–12 mm. long, unexpanded at apex; siliques slender, flattened parallel to septum, divaricate, 2.5–4 cm. long, less than 1 mm. wide, valves faintly nerved below; style about 1 mm. long, slender; seeds oblong, slightly less than 1 mm. long, wingless; cotyledons obliquely incumbent.—Pittonia **3:** 11 (1896); *Cardamine filifolia* Greene, op. cit. **1:** 30 (1887); *Arabis filifolia* Greene, Bull. Calif. Acad. **2:** 390 (1887).—CALIFORNIA: Santa Cruz Island, April, 1888, *T. S. Brandegee* (G); plant grown from seed obtained on Santa Cruz Island, *Greene* (UC, TYPE).

This insular species is not well known, but its specific distinctness must go unchallenged. It is related to *S. pectinata* and *S.*

angelorum, but is amply distinct in many ways. In having incumbent cotyledons, it is similar to *S. laxa* and *S. Brandegeana*.

6. S. PECTINATA Greene. Single-stemmed annual, glabrous and glaucous, branched above, 1–4 dm. high; basal leaves absent or caducous; cauline petiolate, pinnate with narrowly linear, entire segments, 3–6 cm. long; segments 5–15 mm. long, less than 0.5 mm. wide; inflorescence very lax; sepals narrowly ovate to broadly oblong, scarious-margined, non-saccate, obtuse, glabrous, 2–3 mm. long; petals pink to purplish, spatulate, constricted near the middle and notched at apex, 5–6 mm. long; pedicels widely spreading, 8–15 mm. long; siliques straight, flattened, widely spreading, 2.5–4.5 cm. long, about 1.5 mm. wide, valves faintly nerved below; style about 2 mm. long; seeds oblong, wingless, about 1.5 mm. long, about 1 mm. wide; cotyledons accumbent.—Pittonia **3:** 11 (1896); *Arabis pectinata* Greene, op. cit. **1:** 287 (1889).—BAJA CALIFORNIA: Cedros Island, March, 1911, *Rose 16180* (G, NY, US); March, 1889, *Palmer 717* (G, NY, US); March–June 1897, *Anthony 287* (DS, G, NY, US); Cedros Island, Aug. 16, 1932, *J. T. Howell 10688a* (CAS); San Bartolomé Bay, March, 1889, *Lt. Pond* (UC, TYPE); March, 1911, *Rose 16193* (NY, US); Arroyo del Rosarito, 30 miles south of Punta Prieta, March, 1935, *Harbison 11782* (DS).

Though collected first on the mainland of Baja California, most of the material of this species has been obtained from near-by Cedros Island. *S. pectinata* is nearest in its relationship to *S. angelorum*. The chief distinctive character is the rather marked constriction of the petal found in *S. pectinata*, otherwise the two species are very similar. Further knowledge of variation and geographic range may show that *S. pectinata* should not have more than varietal rank under *S. angelorum*, but for the present, such a treatment is hardly warranted.

7. S. ANGELORUM (S. Wats.) Greene. Single-stemmed annual, branched above only, 3–7 dm. high, glabrous and glaucous; basal leaves absent or caducous; cauline petiolate, glaucous, glabrate, pinnate with linear segments, 4–7 cm. long, segments 0.75–1.5 mm. broad, 1–2 cm. long, entire to rarely one- or two-lobed; inflorescence very lax; sepals narrowly ovate, scarious-margined, glabrous, 2.5–3.5 mm. long; petals spatulate, gradually broadening from base to apex, entire, sometimes slightly narrowed near the middle, pink to purplish, 4.5–5.5 mm. long; pedicels widely spreading to somewhat arched downward, 1–1.5 cm. long; siliques slightly curved downward, flat, 2.5–4.5 cm. long, about 1.5 mm. wide, valves nerved below; style slender, 1–1.5 mm. long; seeds oblong, wingless, about 1.5 mm. long, about 1 mm. wide; cotyledons accumbent.—Pittonia **3:** 11 (1896); *Cardamine angelorum* S. Wats. Proc. Amer. Acad. **24:** 39 (1889).—MEXICO: BAJA CALIFORNIA: 39 miles north of San Ignacio, Jan. 1929, *Reed 6249* (G); Los Angeles Bay, Dec. 1887, *Palmer 594* (G, TYPE, NY,

US, isotypes); 8 miles north of San Juanico, March, 1939, *Gentry 4315* in part (G).

S. angelorum is apparently a shade-tolerant plant with limited distribution in the central portion of the Baja California peninsula. Greene made it the type species of *Sibara*.

8. S. LAXA (S. Wats.) Greene. Single-stemmed annual with many long weak and lax branches arising along the main axis, glabrous and glaucous, 4–7 dm. high; strictly basal leaves absent or caducous; cauline petiolate, pinnate with linear segments, 3–5 cm. long, segments 1–2 cm. long, nearly 1 mm. wide; inflorescence loosely racemose; sepals oblong to narrowly ovate, scarious-margined, glabrous; petals oblong to broadly spatulate, entire, often slightly narrowed near middle, purplish, 4–6 mm. long; flowering pedicels sparsely pubescent with simple trichomes; fruiting pedicels reflexed, sparsely pubescent or glabrous, unexpanded at apex, 5–10 mm. long; siliques pendent to reflexed, slightly flattened parallel to septum, 1–1.5 cm. long, about 1.5 mm. wide, valves nerveless; style thick, narrowing from replum to stigma; seeds wingless, oblong, about 1 mm. long, uniseriate; cotyledons incumbent.—Pittonia **3:** 11 (1896); *Nasturtium ? laxum* S. Wats. Proc. Amer. Acad. **24:** 39 (1889).—MEXICO: BAJA CALIFORNIA: 25 miles north of Punta Prieta, April, 1931, *Wiggins 5357* (CAS, DS); 22 miles south of Pozo Alemán, March, 1935, *Wiggins 7853* (DS); sandy plains, Los Angeles Bay, Dec. 1887, *Edward Palmer 598* (G, TYPE, NY, US); Lagoon Head, March, 1889, *Palmer 815* (CAS, G, NY, US); 5 miles southeast of Mesquital Springs, near Santa Rosalia, Jan. 1929, *Reed 6267* (G); 8 miles north of San Juanico, March, 1939, *Gentry 4315* in part (DS).

Watson[5] suggested that this plant might possibly be a *Thelypodium*. It would certainly require a stretch of the imagination to actually place it there. Now that more material is available for study, *S. laxa* is unmistakably related to *S. deserti* and *S. rosulata* on the one hand, and to *S. angelorum* on the other.

9. S. **deserti** (M. E. Jones), comb. nov. Single-stemmed annual, branched or unbranched above, 1–3 dm. high, sparsely pubescent with minute branched trichomes; strictly basal leaves caducous; cauline leaves petiolate, 2–4 cm. long, sparsely pubescent, segments 4–8 mm. long, lower pinnate, upper tending to be entire; inflorescence loosely racemose, rachis somewhat gyrate; sepals oblong, pubescent, scarious-margined, about 2 mm. long; petals white, spatulate, slightly notched at apex, sometimes minutely denticulate at base, 2–3 mm. long; pedicels widely spreading to descending, sparsely pubescent, unexpanded at apex, 3–4 mm. long; siliques flattened parallel to septum, linear, sparsely pubescent, often somewhat curved, slightly descending to loosely reflexed, 1–1.5 cm. long,

[5] loc. cit.

valves nerved below; style rather stout, 1–1.5 mm. long; seeds oblong, wingless, ca. 1 mm. long; cotyledons accumbent.—*Thelypodium deserti* M. E. Jones, Contr. West. Bot. No. **12:** 1 (1908); *Arabis deserti* Abrams, Ill. Fl. Pacific States **2:** 305 (1944).—Death Valley region of Nevada and California. NEVADA: Amargosa Desert, Nye County, April 27, 1907, *M. E. Jones s. n.* (P, TYPE; DS, isotype). CALIFORNIA: north end of Death Valley, near road to Ubehebe Crater, Inyo County, March 25, 1947, *Ferris & Wiggins 11258* (DS); Emigrant Canyon, Panamint Mts., Inyo County, *Barneby 2868a* (CAS).

The foliage and habit of *S. deserti* recall *S. virginica* and *S. mexicana*, but on technical grounds it is more closely related to *S. laxa*. Payson (in a letter to Mrs. Ferris) some years ago suggested that *Thelypodium deserti* of M. E. Jones was probably to be associated with species of *Sibara*. In my opinion this is the correct disposition, although, as Jones[6] points out, it resembles in a general way *Streptanthella longirostris* (*Streptanthus longirostris*). The latter species most certainly has a different relationship, however, and should either remain as a monotype, or if incorporated in a larger genus, then it should be shifted toward *Thelypodium*.

Root-tips of several seedlings of *S. deserti* have been smeared for chromosome counting. The chromosome number in all instances was found to be 2n = 26. Seeds from Ferris and Wiggins no. 11258 were used to produce the seedlings.

10. S. **rosulata,** sp. nov. Herba annua; caulibus ramosis glabris vel sparse pubescentibus 1–3 dm. altis; foliis basilaribus petiolatis rosulatis pinnatisectis persistentibus glabris vel sparse pubescentibus 3–5 cm. longis; foliis caulinis pinnatifidis vel integris; sepalis glabris vel sparse pubescentibus oblongis 1.5–2 mm. longis; petalis albis spathulatis 2.5–3 mm. longis; pedicellis glabris divaricato-adscendentibus 2–3 mm. longis; siliquis linearibus glabris 1.5–3 cm. longis 1–1.5 mm. latis; stigmatibus integris; seminibus oblongis ca. 1 mm. longis; cotyledonibus accumbentibus.

Annual; stems one or rarely few, terete, slightly gyrate, divaricately branched above, glabrous to very sparsely pubescent, 1–3 dm. high, branches filiform, subtended by entire or subentire leaves; leaves dimorphic, basal leaves rosulate, deeply pinnately lobed, persistent, glabrous to sparsely pubescent with simple or branched trichomes, petiolate, 3–5 cm. long, lobes 1–2 mm. wide, 4–8 mm. long, lower cauline leaves somewhat lobed, upper entire and linear; inflorescence loosely racemose; sepals nonsaccate, very sparsely pubescent to glabrous, scarious-margined, oblong, 1.5–2 mm. long, petals white, narrowly spatulate, obscurely emarginate

[6] op. cit. 2.

at apex, 2.5–3 mm. long; paired stamens very slightly longer than single stamens; siliques linear, divaricately ascending, widely spaced on the rachis, glabrous, flattened parallel to septum, 1-nerved to middle or above, 1.5–3 cm. long, 1–1.5 mm. wide; styles club-shaped, 2–3 mm. long; stigma entire; fruiting pedicels divaricately ascending, glabrous, 2–3 mm. long; seeds wingless, oblong, ca. 1 mm. long; cotyledons accumbent.—Death Valley region of southeastern CALIFORNIA: mouth of Emigrant Canyon, Panamint Mts., Inyo County, *Ferris, Scott & Bacigalupi 3990* (DS); same locality, *R. C. Barneby 2868* (CAS); south end of Panamint Valley, Inyo County, *Train 515* (DS, US); west side of Townes Pass, Panamint Mts., *Eastwood & Howell 7693* (CAS); Titus Canyon, east side of Death Valley, T 13 S, R 45 E, Inyo County, elev. 3300 ft., March 26, 1947, *David D. Keck & Roxana S. Ferris 5804* (DS, TYPE); Nevares Peak, Funeral Mts., Death Valley, *Gilman 1248* (US); Nevares Canyon, Death Valley, *Abrams 13779* (DS); Grotto Canyon, Death Valley, *Epling, Robison & Haines s. n.* (CAS).

Until the recent collections of *Sibara* from Death Valley made by Mrs. Roxana Ferris, Dr. David D. Keck and Dr. Ira L. Wiggins, it had been supposed that a single species, *S. deserti*, was present in this area of California. The material previously studied did not agree in several details with the type series of *S. deserti*, but it was presumed that the latter represented an unusual population of the species as a whole. However, with another extensive collection (*Ferris and Wiggins 11258*) of typical *S. deserti* available for study, a new interpretation of the total material of *Sibara* from the Death Valley region is indicated. It now seems reasonably certain that the type series of *S. deserti* represents a species distinct from the bulk of known material from the area in question rather than an unusual population of the same species.

S. rosulata and *S. deserti* are closely related, but differ in a number of important characters. The pubescence of *S. deserti* is minute, highly branched and is rather abundant on the leaves, stems, pedicels and siliques. The pubescence of *S. rosulata* is much coarser and is simple or merely forked rather than highly branched. It is very sparse on the leaves and lower stems and practically absent elsewhere on the plants. The siliques in particular are wholly glabrous. *S. rosulata*, as the name suggests, has a rosulate cluster of persistent leaves at the base of the stem, but such leaves are early shed by *S. deserti*. In the latter species the pedicels are loosely reflexed, making the short siliques pendulous, while in *S. rosulata* the straight, longer siliques and shorter pedicels are divaricately ascending. *S. deserti* tends to have

pinnatifid cauline leaves, whereas in *S. rosulata* they tend to be entire even toward the basal portion of the stem.

11. S. Brandegeana (Rose) Greene. Single-stemmed annual, divaricately branched above, glabrous and somewhat glaucous, 2–4 dm. high; stems purplish; basal leaves absent or caducous; cauline pinnate with narrowly linear segments, petiolate, 1–3 cm. long, segments 5–10 mm. long, obtuse; mature inflorescence extending from near base to apex; sepals oblong, scarious-margined; petals purplish, oblong, minutely denticulate near base, 3–4 mm. long; pedicels geniculately reflexed, stout, glabrous, 2–4 mm. long; siliques nearly terete, reflexed or laxly descending, straight to slightly curved upward, 1–1.5 cm. long, slightly more than 1 mm. broad; style thick, club-shaped, about 2 mm. long; seeds oblong, wingless, about 1 mm. long; cotyledons incumbent.—Pittonia **3:** 11 (1896); *Sisymbrium Brandegeanum* Rose, Contr. U. S. Nat. Herb. **1:** 10 (1890); *Microsisymbrium lasiophyllum* (Hook. & Arn.) O. E. Schulz, f. *Brandegeanum* O. E. Schulz, Pflanzenreich 4^{108}**:** 163 (1924).—Mexico: Baja California: Lagoon Head, March 6–15, 1889, *Edward Palmer 821* (US, type, G, UC, isotypes); San Bartolomé Bay, March, 1911, *Rose 16227* (G, NY, US); San Quintín, April, 1936, *Epling & Stewart s. n.* (DS, NY); near Calmallí, *C. R. Orcutt s. n.* (UC).

S. Brandegeana is not as well placed in *Sibara* as are the other species, even though its foliage is highly pectinate and most of its other characters simulate those of the other species. In this species, the siliques are terete and the pedicels are very thick like some species of *Sisymbrium*. However, I do not see how the species can be removed from its present disposition on good grounds.

Species excluded from Sibara

1. *S. Palmeri* (Wats.) Greene in Pittonia **3:** 12 (1896) = *Dryopetalon Palmeri* (Wats.) O. E. Schulz in Notizbl. **10:** 561 (1929).

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ERRATA

Page 97, line 14, *for* 121 *read* 118.
Page 97, line 30, *for* calcye *read* calyce.
Page 99, line 12, *for* coàrser *read* coarse.
Page 99, line 17, *for* every respect *read* many respects.
Page 102, line 38, *for* Southampton *read* Hudson.
Page 103, line 34, *for* almost *read* various.
Page 104, line 16, *for* 370 *read* 270.
Page 104, line 19, *for* crenulations *read* crenations.
Page 104, line 23 et seq. *for* Nottingham et seq. *read* Southampton, Walrus and Coats.
Page 104, line 42, *for* 47 *read* 147.
Page 105, line 24, *for* North *read* Arctic.

CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD UNIVERSITY

No. CLXVI

1. Studies in the *Iridaceae*,—V 3
2. Studies in the Flora of Bolivia,—II 28

By

Robert C. Foster

Published by
THE GRAY HERBARIUM OF HARVARD UNIVERSITY
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ISSUED JUN 22

1. STUDIES IN THE IRIDACEAE,—V.

Some New or Noteworthy Species of Hesperantha

In 1939, before the outbreak of the war, material of *Hesperantha* was secured from several of the larger European herbaria. As work progressed, it became apparent that a more satisfactory treatment could be given if material were secured from the South African herbaria. Consequently, study was suspended until the end of the war. Before it became possible to borrow from South Africa, it became necessary to return an important part of the specimens, including many types. As a result, it seems to me unwise to attempt a monographic treatment at present, and I give here the descriptions of several novelties, as well as notes on other species. In addition to the few specimens available in the Gray Herbarium (G), material has been seen from the Royal Botanic Gardens, Kew (K), the Berlin Museum (B), and the Conservatoire Botanique, Genève (Gen). I am indebted to the late Sir Arthur W. Hill, the late Professor L. Diels and Professor B. P. G. Hochreutiner for their kindness in making this material available to me.

Hesperantha acuta (Lichtenst.) Ker, Irid. Gen. 91 (1827).

Ixia acuta Lichtenst. in Roem. & Schult. Syst. Veg. i. 383 (1817).

Corm unknown. Basal leaves 3, mostly incomplete on the type, but the uppermost long-sheathing, to 21 cm. long, 2 mm. wide, linear-attenuate, acute, glabrous, the midrib thickened and the margins incurved; cauline leaf 7 cm. long, sheathing for half its length. Stem simple, terete, glabrous, 30 cm. tall, the inflorescence a lax, distichous, flexuose, 3–5-flowered spike. Outer spathes to 1.2 cm. long, lanceolate-ovate, acute, herbaceous, the inner spathes to 1 cm. long, scarious, bicarinate, somewhat bifid at the apex. Ovary narrowly ellipsoid, to 4 mm. long. Perianth-tube to 1.2 cm. long, exceeding the outer spathe, slender, ampliate at the apex, straight; tepals subequal, to 1 cm. long, the outer 3 mm. wide, the inner 4 mm. wide, oblanceolate, acute, flaring almost at right angles to the tube, the outer series reddish-brown (at least on the exterior), the inner pale. Anthers to 7 mm. long; filaments 3 mm. long. Style about as long as the perianth-tube; style-arms 5 mm. long, much shorter than the anther-apex. Capsule and seeds not seen.

CAPE PROV.: "In Karroo ad pedem montis Roggeveldsberg", *Lichtenstein* (type, B).

In the original description, it is stated that the inflorescence is secund, and if that is based on Lichtenstein's observations on

living plants it is undoubtedly correct. As prepared, however, the type shows a rather distichous spike. This detailed description has been given because it seems to me that *H. acuta* is a distinct species which has not been recognized in the past, possibly because of inadequate descriptions, or possibly because the type had not been sufficiently studied by previous workers on the genus.

H. Bachmannii Baker in Bull. Herb. Boiss. (II) i. 863 (1901).

H. angusta of authors, as to most specimens cited.

Corm ovoid to subglobose, to 1.2 cm. high and 1 cm. wide, the firm tunics subimbricate, apically short-cusped, the bases smoothly and regularly V-notched. Basal leaves 2–3, to 32 cm. long, 2–3 mm. wide, basally sheathing, linear, acute, glabrous, the midrib and edges rather prominent; cauline leaves 1–2, very long-sheathing, to 22 cm. long. Stem 1–4-branched, to 40 cm. tall, terete, glabrous, the main axis with a lax, distichous, 2–6-flowered spike, the branches 1–2-flowered. Outer spathes to 2.8 cm. long, submembranaceous, few-nerved, apically retuse; inner spathes to 2.5 cm. long, scarious, bicarinate, somewhat bifid. Ovary subturbinate, to 8 mm. long. Perianth-tube to 8 mm. long, strongly curved at the apex, the flower pointing downward in anthesis; tepals subequal, to 2.4 cm. long and 7 mm. wide, strongly reflexed, white, oblanceolate to oblong-ovate, from subacute to minutely emarginate at the apex. Anthers 4–7 mm. long; filaments about as long as the anthers. Style equal to or slightly exceeding the perianth-tube; style-arms to 1.4 cm. long, from shorter to longer than the anther-apex. Capsule ovoid to turbinate, rounded-trigonal, to 1.2 cm. long; seeds about 2 mm. long, subglobose, alate, brown.

CAPE PROV.: Little Namaqualand: veld between Bitterfontein and Stinkfontein, Sept. 10, 1911, *Pearson*, no. 6562 (B); Khamiesberg, 1911, *Pearson*, no. 6666 (B); Khamiesberg, Karkams, among bushes, Oct. 11, 1911, *Pearson*, no. 6561 (K); near Ookiep, 1878, *Morris in Herb. H. Bolus*, no. 5787 (K); Richtersveld Distr., Kubus, Main Kloof, 300 m. alt., Aug. 29, 1925, *Marloth*, no. 12369 (B); near Klipfontein, 3000 ft. alt., August, 1883, *Bolus in Herb. Norm.*, no. 693 (G, K, Gen); Clanwilliam Div.: east of Clanwilliam, 95 m. alt., Sept. 2, 1900, *Diels*, no. 291 (B); on the Olifantsrivier near Villa Brakfontein, August, *Ecklon & Zeyher*, Irid. no. 231 (G, B, Gen); Olifants River Valley, August, 1925, *Lavis* (K); 4 miles north of Citrusdal, Sept. 5, 1933, *Salter*, no. 3609 (K); near Clanwilliam, Sept. 15, 1933, *Salter*, no. 3681 (K); near Olifant Rivier, 133 m. alt., Aug. 24, 1893, *Schlechter*, no. 4999 (G, K, Gen); Koude Berg, 2400 ft. alt., Aug. 28, 1896, *Schlechter*, no. 8726 (K, B, Gen); Calvinia Div.: Südabfall der westlichen Hantams-Berge, 1050 m. alt., Sept. 16, 1900, *Diels*, no. 739 (B); Hantam Mts., 1869, *Dr. Meyer*, no. 16 (B); Malmesbury Div.: near Hopefield, at Zwartland, August, 1885, *Bachmann*, no. 1177 (type, Herb. Zürich, not seen; photo, G; isotype, K); Ceres Div.: Karroo, Zwartkoppies, near Spes Bona, 650 m. alt., September, 1921,

Marloth, no. 10470 (B); Ceres, 1000 m. alt., October, 1903, *Marloth*, no. 3321 (B); Worcester Div.: Hex River Kloof, 1000–2000 ft. alt., *Drège*, no. 525 in part (B); same locality, *Drège* (K, Gen); Humansdorp Div.: between Zuurbron and Gamtoos River drift, 400 ft. alt., September, 1928, *Fourcade*, no. 3987 (K); Uitenhage Div.: Uitenhage, *Zeyher* (B); Enon, Sept.–Oct. 1930, *J. Thode*, no. A 2762 (K); Port Elizabeth Div.: Red House, near Port Elizabeth, *West*, no. 113 (K); Somerset East Div.: Klyn Vischrivier, 2800 ft. alt., Sept.–Oct. 1870, *MacOwan*, no. 345b (K, Gen).

This species has been dealt with in some detail, partly because the original description was rather inadequate, and partly because most of the material passing as *H. angusta* (Jacq.) Ker actually belongs here. In fact, I have seen no material which can safely be assigned to *H. angusta*. As shown in Jacquin's beautiful plate, Icones, ii, t. 279, that species has a conic corm, broadest at the flat base, with strongly imbricate tunics, these tunics broken from the base upward into broad strips whose bases are highly serrate. Even if no other differences were apparent, the differences in the corms would keep the two species apart.

Although I have not seen the type of *H. Bachmannii*, an isotype has been available, as well as an excellent photograph of the type, for which I am indebted to Professor Hochreutiner.

H. **bicolor** (Baker), comb. nov.

H. candida var. *bicolor* Baker in Fl. Cap. vi. 63 (1896).

Corm subglobose, about 1 cm. high, 1 cm. in diameter, the tunics concentric (?). Basal leaves 3, to 20 cm. long, 4–5 mm. wide, linear to subfalcate, acute, glabrous, more or less glaucous, the midrib and edges thickened and 2 other nerves prominent; cauline leaf placed low on the stem, about 4 cm. long, half-sheathing. Stem simple or (usually) branched from near the base, terete, glabrous, about 16 cm. tall, the inflorescence a rather compact, distichous 2–6-flowered spike. Outer spathes to 2.2 cm. long, oblong-ovate, subobtuse or abruptly acute, sometimes almost mucronulate, herbaceous, with the apex membranous, subglaucous; inner spathes to 1.7 cm. long, membranous, bicarinate, bifid at the apex. Ovary about 5 mm. long. Perianth-tube straight, to 1.2 cm. long; tepals subequal, the outer series to 2 cm. long, 5–6 mm. wide, lance-ovate to obovate, subacute, white, drying reddish-purple on the exterior; inner tepals nearly as long and slightly wider, obovate, acute, white. Anthers 5–8 mm. long, about half the length of the inner tepals; filaments ca. 3 mm. long. Style 8–10 mm. long; style-arms to 1.5 cm. long, equaling or exceeding the anther-apex. Immature capsule turbinate; seeds not seen.

CAPE PROV.: Somerset East Div.: Boschberg, 4000 ft. alt., November, *MacOwan*, no. 61 in part (type, K); Aliwal North Div.: Ruigtefontein, August–September, 1929, *J. Thode*, no. A 1868 (K).

Baker's choice of an epithet for his variety was somewhat unfortunate, since the label of the type has on it the following note: "Fl. albi exsicco purpurasc." Furthermore, Baker's first impression of this plant was correct, when, in 1892, Handbk. Irid. 151, he suggested that it "is very likely a distinct species." It differs from *H. candida* Baker in flower-color, the number of flowers usually found in an inflorescence, in branching, longer perianth-tube, leaves thicker in texture, and in style-arms which are often much longer than the anther-apex. These differences seem to warrant specific rank for the plant.

H. **Bolusii,** spec. nov.

Cormus ignotus. Folia basalia 2, lineari-falcata, 5–20 cm. longa, 2.5 mm. lata, apice rotundata vel abrupte acuta, nervus primarius et margines incrassati; folium caulinum ad 10 cm. longum, plurinervatum, basi longe vaginans. Caulis simplex vel 1-ramosus, teres, glaber, ad 30 cm. altus, plerumque brevior; inflorescentia spica laxa, flexuosa, disticha, 2–4-fl. Spatha exterior ad 1.1 cm. longa, herbacea, 6–8-nervata, spatha interior parum brevior, hyalina, bicarinata, apice emarginata. Ovarium turbinatum, 4–5 mm. longum. Perianthii tubus rectus vel parum curvatus, spatham exteriorem longitudine aequans vel excedens, cylindricus, 6–9 mm. longus; tepala subaequalia, ad 1.4 cm. longa, 6 mm. lata, ovato-obovata, apice obtusa, alba. Filamenta filiformia, 3 mm. longa; antherae ad 6 mm. longae, sagittatae. Stylus 7 mm. longus; styli rami 9 mm. longi. Capsula turbinata, 6 mm. longa, papyracea; semina subglobosa, 1 mm. diam.

CAPE PROV.: Little Namaqualand: Nababeep, 3200 ft. alt., September, 1883, *Bolus in Herb. Norm.*, no. 694 (type, G; isotypes, K, B, Gen).

This species is undoubtedly closest to *H. flexuosa* Klatt, but differs in its larger, concolorous flowers, with a longer perianth-tube, this often exceeding the spathes by as much as 4 mm., and in its much longer style-arms.

H. **bracteolata,** spec. nov.

Cormus disruptus sed manifeste ovoideo-globosus, 7 mm. altus, ca. 6 mm. diametro, tunicae concentricae, apice brevicuspidatae, cretaceo-brunneae. Folia basalia 3, vaginantia, falcata, attenuata, apice obtusa, 5–9 cm. longa, 1–1.5 mm. lata; folia caulina nulla. Caulis simplex, teres, glaber, 8–12 cm. longus, 1–2-fl., bracteolis duabus minutis, pallide roseis, membranaceis, ovato-lanceolatis, oppositis, 1–3 cm. infra inflorescentiam ornatus. Spathae valvae aequales, 8–10 mm. longae, exterior lanceolato-ovata, obtusa vel leviter et abrupte acuta, herbaceo-membranacea, interior membranacea, bicarinata, leviter bifida. Ovarium turbinato-oblongum, ad 3 mm. longum. Perianthii tubus rectus, ad 7 mm. longus, apice leviter ampliatus; tepala subaequalia, exteriora ad 1.4

cm. longa, 2 mm. lata, anguste oblanceolata vel elliptica, acuta, interiora ad 1.2 cm. longa, 3–3.5 mm. lata. Antherae 4 mm. longae; filamenta 2 mm. longa. Stylus quam tubus 1–1.5 mm. brevior; styli rami ca. 4 mm. longi. Capsula seminaque non visa.

CAPE PROV.: SUTHERLAND DIV.: Roggeveld, Farm Uitkyk, Sneuwkrans, top of the mountain, 1700 m. alt., October, 1920, *Marloth*, no. 9907 (TYPE, B).

According to the collector's label, the flowers are blue, but they dry a light red-purple. Its small size, few flowers, and the minute bracteoles on the stem, replacing cauline leaves, serve to distinguish this species rather well from its relatives in the *flexuosa*-group. The type bears an unpublished binomial given by Schlechter, but since he incorrectly assigned the plant to *Geissorhiza*, and since the minute bracteoles on the stem are a development not seen by me in any other species, I have not taken up Schlechter's unpublished specific epithet.

H. BREVICAULIS (Baker) Lewis in Journ. S. Afr. Bot. vii. 30 (1941).
Acidanthera brevicaulis Baker in Fl. Cap. vi. 132 (1896).

Plant 22 cm. tall. Corm unknown. Leaves 4, basal, superposed, sheathing the stem nearly to the inflorescence, to 30 cm. long, 2–4 mm. wide, linear, acute, glabrous, the midrib and edges thickened. Stem simple, terete, glabrous; inflorescence 2–flowered, the flowers 1.5 cm. distant. Outer spathe 2.5–2.8 cm. long, herbaceous, oblong, acuminate, acute, subcarinate; inner spathe 2 cm. long, somewhat hyaline-membranous. Ovary 4–5 mm. long, turbinate. Perianth-tube ca. 3.5 cm. long, cylindrical; tepals subequal, ca. 2.5 cm. long, 7 mm. wide, oblanceolate to obovate, subacute, pink (*fide* Galpin). Anthers linear, sagittate, 1 cm. long; filaments 7–8 mm. long. Style ca. 3 cm. long; style-arms ca. 2 cm. long. Capsule and seeds unknown.

TRANSVAAL: BARBERTON DISTR.: Devil's Bridge, Makwonga Range, near Barberton, 5000 ft. alt., March, 1891, *Galpin*, no. 1252 (TYPE, K).

Although Miss Lewis (l. c.) had not seen the type of *Acidanthera brevicaulis*, and made the transfer on the basis of the original description, she was correct in doing so. The same conclusion had been reached by me before her publication appeared, and by the late Dr. N. E. Brown before me. On the type, Dr. Brown noted (in pencil), "Style-branches very long = *Hesperantha*", and (in ink) made the combination *H. brevicaulis*, a combination which he did not live to publish.

H. BUHRII L. Bol. in Journ. Bot. lxix. 13 (1931).

Corm subglobose, basally somewhat flattened, 1.5 cm. wide, 1 cm. high, the tunics imbricate, apically short-cusped, basally V-notched, dull brown-black. Basal leaves 3, 14–21 cm. long, 4–5 mm. wide, linear,

acute, glabrous, the nerves subprominent; cauline leaf and branch-leaf 11–9.5 cm. long, the sheaths subventricose. Stem 2-branched, the main axis flexuose, 22–27 cm. long, terete, glabrous, the inflorescence a 6–7-flowered, lax, distichous spike, the flowers distant, the branches 4–7-flowered. Outer spathe to 1.8 cm. long, herbaceous, somewhat membranous at the tip, 5-nerved, carinate, oblong-ovate, subacute; inner spathe to 7 mm. long, somewhat membranous, bicarinate. Ovary oblong-ovoid, 3–5 mm. long. Perianth-tube 1–1.4 cm. long; tepals subequal, 1.5–2 cm. long, 6–9 mm. wide, obovate, obtuse or subacute, the outer series flushed pink or purple on the exterior, the inner series white. Anthers to 9 mm. long; filaments 3–4 mm. long. Style 7–8 mm. long; style-arms to 7 mm. long, about half to two-thirds as long as the anther-apex. Capsule and seeds not seen.

CAPE PROV.: Calvinia Div.: Nieuwoudtville, Aug. 10, 1931, *Buhr* (Nat. Bot. Gards. 373/31) (K).

The original description cited a specimen collected by Mr. Buhr at Nieuwoudtville, but stated that the description was drawn up "from a living plant which flowered in Miss Stanford's garden, September, 1929." Consequently, the specimen cited here cannot be regarded as type-material, but is probably a topotype. In its general aspects, the species is related to *H. inflexa* but differs in its color and in the long perianth-tube. It is possible that *Meyer*, no. 17, from the Hantam Mts. (B), may belong here.

H. bulbifera Baker in Journ. Bot. xiv. 183 (1876).

Corm unknown. Plant about 50–60 cm. high. Basal leaves 2, equaling or exceeding the stem, linear, long-acute, glabrous, flaccid, 54–60 cm. long, 7–8 mm. wide; cauline leaves 2, lax, each with a bulbil at the base of the sheath, the midrib and several other nerves prominent, the margins thickened. Stem simple, terete, glabrous, the inflorescence a lax, distichous, 4-flowered spike. Outer spathe 2–3 cm. long, 9-nerved, carinate, ovate-lanceolate, thin-textured, emarginate at the apex; inner spathe as long as the outer, hyaline, bicarinate, bifid at the apex. Ovary 3–4 mm. long, subturbinate. Perianth-tube curved into a semi-circle, 7–8 mm. long, widening gradually from the base, then contracted somewhat at the throat; tepals subequal, the outer 2.5 cm. long, 7 mm. wide, the inner 2.3 cm. long, 7 mm. wide, oblong-ovate, obtuse, white. Anthers 1.2 cm. long; filaments 7 mm. long, rather broad, flat. Style ca. 6 mm. long; style-arms ca. 2 cm. long, exceeding the anther-apex. Capsule and seeds not seen..

CAPE PROV.: Somerset East Div.: in rimis scopulorum ad cataractas Mtis. Boschberg, *MacOwan*, no. 2215 (type, K).

Baker, in a later treatment, Handbk. Irid. 152 (1892), did not give a description of this species, suggesting that it was but a variety of *H. angusta*. In Fl. Cap. vi. 65 (1896), he gave it

separate treatment, cautiously adding "Perhaps only a form of *H. angusta*, grown in damp shade." I am inclined to think it deserves specific rank.

H. CUCULLATA Klatt, Ergänz. 59 (1882); Baker, Handbk. Irid. 149 (1892); Baker in Fl. Cap. vi. 60 (1896).

H. montana Klatt, Ergänz. 59 (1882); Baker, Handbk. Irid. 148 (1892); Baker in Fl. Cap. vi. 58 (1896).

Corm ovoid-globose, to 1.5 cm. high, 1 cm. wide, the tunics imbricate, V-notched at the base, firm, castaneous. Basal leaves 4, closely superposed, to 9 cm. long and 8 mm. wide, long-sheathing, rather firm-textured but not coriaceous, glabrous, falcate, acute, the midrib and a few other nerves rather prominent; cauline leaf to 7 cm. long, the sheath ventricose, the blade bent away from the stem at an acute angle. Stem simple or 1–2-branched from the base or the axil of the cauline leaf, to 11 cm. long, terete, glabrous, the main axis with a lax, 2–3-flowered, distichous spike, the branches 1–2-flowered. Outer spathes to 1.5 cm. long, oblong-ovate, abruptly and often obscurely acute, herbaceous, firm-textured; inner spathes about 2 mm. shorter, mostly scarious, bicarinate, bifid at the apex. Ovary narrowly ellipsoid, 2.5 mm. long. Perianth-tube to 7–10 mm. long, straight, somewhat ampliate at the throat; outer tepals to 1.5, or exceptionally to 1.8, cm. long, from 3 to 7–8 mm. wide, obovate, obtuse, reddish-purple; inner tepals about 2 mm. shorter than the outer and 1–2 mm. wider, lighter in color, possibly white. Anthers 6–7 mm. long; filaments 4–5 mm. long. Style a little longer than the perianth-tube, or equaling it; style-arms to 1.2 cm. long, equaling or slightly exceeding the anther-apex. Capsule more or less turbinate, to 1.2 cm. long; mature seeds not seen.

CAPE PROV.: CALVINIA DIV.: Hantam Mts., in 1869, *Dr. Meyer*, no. 9 (TYPE, B), no. 18 in part (B), and no. 21 (type of *H. montana*, B).

The two species, *H. cucullata* and *H. montana*, were described on the same page by Klatt. Although the type of *H. montana* now has neither flowers nor corm, what is left appears identical in most respects with the type of *H. cucullata*. In view of the more complete preservation of the latter, with flowers and the remnants of a corm, it seems advisable to retain that name, making *H. montana* a synonym. The original description differentiated the two by flower-color, a point followed by Baker, *H. cucullata* being reported as uniformly lilac and *H. montana* as bicolored. The present condition of the type of *H. cucullata* suggests to me that it, too, may have been somewhat bicolored.

H. DISCOLOR N. E. Br. in Kew Bull. 1931: 451.

Corm small, ovoid-globose, 8 mm. high, 6 mm. wide, the tunics concentric, castaneous, apically short-cusped, with a short columnar base. Basal leaves 2–3, 8–20 cm. long, 1.5–3 mm. wide, linear-attenuate, acute,

glabrous, the midrib thick; cauline leaves 1–2, 4–15 cm. long, the upper mostly sheathing. Stem 16–30 cm. long, simple or 1-branched in the axil of the lower cauline leaf, terete, glabrous, the main axis bearing a simple, lax, distichous, flexuose, 5–8-flowered spike, the branch few-flowered (to 4). Spathes subequal, or the inner slightly shorter than the outer, to 1.7 cm. long, oblong-ovate, acute or obtuse, herbaceous, 9–11-veined, the inner more or less bifid at the apex, hyaline-membranous, bicarinate. Ovary ellipsoid, 3–4 mm. long. Perianth-tube to 1.2 cm. long, straight, slightly ampliate at the top; tepals 1.2–1.8 cm. long, 4–5 mm. wide, subequal, oblanceolate to obovate, more or less obtuse or subacute, the outer series red or red-brown on the exterior, the inner series pale yellow or white. Anthers to 6 mm. long; filaments 3–4 mm. long. Style to 1.1 cm. long, shorter than the perianth-tube; style-arms to 6–8 mm. long, shorter than the anther-apex. Capsule turbinate, to 9 mm. long, thin-walled; seeds globose, light brown, 0.5–1 mm. in diameter.

CAPE PROV.: Worcester Div.: between Osplaats and Tunnel Sidings, 2000–3000 ft. alt., August, 1915, *F. A. Rogers*, no. 16740 (type, K); Brandt Vlei, near Worcester, Apr. 26, 1928, *Hutchinson*, no. 133 in part (K); Riversdale Div.: Riversdale, 1891–93, *Rust*, no. 45 (B).

Although in the original description this species was compared with *H. pilosa*, it seems to me to have a closer resemblance to *H. falcata*. In differs from that species, however, in having the corm-tunics entire and concentric, instead of imbricate and irregularly serrate at the base. The leaves of *H. discolor* are not markedly falcate and are, for the most part, erect or suberect.

H. erecta (Baker) Benth. ex Baker, Handbk. Irid. 150 (1892); Baker in Fl. Cap. vi. 61 (1896).

Geissorhiza erecta Baker in Journ. Bot. xiv. 238 (1876); Baker in Journ. Linn. Soc. Bot. xvi. 93 (1877); Klatt, Ergänz. 58 (1882).

Corm subglobose, ca. 1 cm. high, the tunics apparently concentric, crustaceous, brown. Basal leaves 2, to 13 cm. long, 2–3 mm. wide, linear, glabrous, the midrib and edges thickened; cauline leaf similar to the basal leaves and somewhat shorter. Stem simple or branched, to 20 cm. long, terete, glabrous; inflorescence a lax, distichous, 5–7-flowered spike. Spathes subequal, but the inner 1–2 mm. shorter than the outer, to 1–1.3 cm. long, herbaceous, lanceolate-ovate, carinate, obtuse or abruptly acute, the inner spathe hyaline, emarginate, bicarinate. Ovary to 3–4 mm. long, oblong-ellipsoid. Perianth-tube equal to or a little longer than the outer spathe, straight, ampliate at the apex, 7–8 mm. long; tepals subequal, the outer a little longer than the inner, to 1.2 cm. long, 3–4 mm. wide, obovate, obtuse at the apex, pale red, concolorous (*fide* Baker). Filaments ca. 3 mm. long; anthers to 7 mm. long, nearly as long as the apex of the inner tepals. Style about 6 mm. long; style-arms 6–7 mm. long. Capsule and seeds unknown.

CAPE PROV.: Van Rhynsdorp Div.: north of the Olifantsrivier, below 1000 ft. alt., August, *Drège*, no. 8468 (type, K; isotype, Gen).

The transfer of *Geissorhiza erecta* to *Hesperantha* is usually credited to Bentham in Gen. Pl. iii. 703 (1883), but the transfer was incomplete. The actual phrasing was as follows: "(excl. *G. erecta*, . . . ad *Hesperantham* referendis)." The first use of the binomial, *Hesperantha erecta*, appears to be that of Baker, as cited above.

There is a strong possibility that *H. erecta* and *H. discolor* are conspecific, although probably varietally distinct. The two specimens of *H. erecta* which have been available are badly discolored, and the corm on the type has been broken. From its remnants, however, it appears like that of *H. discolor*. The two species are similar in leaves, general dimensions, and in flower-size. In fact, the low-branched stem and reported uniformly pale red color of *H. erecta* seem to be the only points of difference from the simple-stemmed bicolored *H. discolor*. In the absence of good and complete material, their separate status is retained for the present.

H. FIBROSA Baker, Handbk. Irid. 149 (1892); Baker in Fl. Cap. vi. 61 (1896).

Corm more or less globose but flat-based, 1 cm. high, 1.2 cm. wide, the tunics concentric, apically produced into fibres 1.5–5.5 cm. long. Basal leaves 3, the lowermost a 4 cm. sheathing cataphyll, the 2 produced leaves to 15 cm. long, 2.5 mm. wide, basally rather long-sheathing, linear-attenuate, obtusely rounded at the apex, the midrib and incurved margins often sparsely and minutely ciliolate; cauline leaf 6–7 cm. long, half-sheathing. Stem simple, terete, glabrous, 13–24 cm. long, somewhat flexuose, the inflorescence a 2–4-flowered, lax, distichous spike. Outer spathe to 1.2 cm. long, as long as or longer than the perianth-tube, oblong-ovate, abruptly acute or retuse at the apex, the inner spathe nearly as long as the outer, or sometimes longer, scarious, bicarinate, slightly bifid at the apex. Ovary to 2 mm. long, narrowly ellipsoidal. Perianth-tube to 7 mm. long, straight, slightly ampliate at the apex; tepals subequal, the inner slightly shorter than the outer, to 1.2 cm. long, 2.5 mm. wide, obovate, acute, concolorous, reddish-purple (?). Anthers 5 mm. long; filaments ca. 3 mm. long. Style about 7 mm. long; style-arms 6 mm. long, nearly equaling the anther-apex. Capsule and seeds not seen.

CAPE PROV.: CALEDON DIV.: Kleinriviersberg, August, 1000–3000 ft. alt., *Zeyher*, no. 3960 (isotype, B); Zwartberg, 1000–2000 ft. alt., August, *Ecklon & Zeyher*, Irid. no. 238 (B) and 239 (B).

The last collection cited, *Ecklon & Zeyher*, no. 239, has leaves which are much shorter, broader and more falcate than those of the type-number.

H. FISTULOSA Baker in Bull. Herb. Boiss. (II) iv. 1004 (1904).

Corm ovoid-conic, usually broadest at the flat base, 1.5 cm. wide, 1.5

cm. high, the tunics closely imbricate, the basal edges irregularly serrate, apically short-cusped. Basal leaves 3, the lowermost a scarious sheath up to 2.5 cm. long, the produced leaves suberect to spreading, to 20 cm. long, 2.5 mm. wide, terete, fistulose, glabrous, many-nerved, acute; cauline leaves 1–2, 1.5–8 cm. long, almost completely sheathing. Stem simple, terete, glabrous, to 38 cm. long (usually much shorter), much exceeding the leaves, the inflorescence a semi-compact, secund, 6–9-flowered spike. Outer spathe to 5 mm. long, oblong, abruptly acute or obtuse, sometimes slightly retuse, green, with a scarious tip; inner spathe as long, scarious, bicarinate, bifid at the apex. Ovary 2 mm. long. Perianth-tube curved from the base, to 4 mm. long, exceeding the spathes; tepals subequal, to 6 mm. long, 2 mm. wide, oblong-ovate, obtuse, the outer series red-brown on the exterior, the inner series white or yellowish. Anthers 3 mm. long; filaments 2.5 mm. long. Style about 3 mm. long, shorter than the perianth-tube; style-arms 2 mm. long. Mature capsule and seeds not seen.

CAPE PROV.: Piquetberg Div.: hills near Porterville, 900 ft. alt., Aug. 18, 1894, *Schlechter*, no. 4885 (type, Gen, not seen; photo, G; isotypes, Gen, B); near Porterville, 450 ft. alt., Aug. 4, 1897, *Schlechter*, no. 10731 (B).

It is possible that this species, which is close to *H. graminifolia*, should be united with it as a well-marked variety. It differs, however, in having the spathes about the same length, instead of the inner much longer than the outer, in the fistulose terete leaves, and in having a different flower-color, at least so far as the outer tepals are concerned. These characters, it seems to me, warrant the retention of specific status.

H. flava Lewis in S. Afr. Gard. xxiii. 255, and Fig. A, 266 (1933).

Plant about 7 cm. tall. Corm ovoid-conic, 1.5–2 cm. high, 1–1.5 cm. wide, the tunics imbricate, crustaceous, dark brown, the inner coats punctate. Basal leaves 3, the lowermost a scarious subterranean cataphyll 2.5–3 cm. long, the produced leaves 5–7 cm. long, 4–9 mm. wide, long-sheathing, the edges thickened, the midrib prominent, the blade adaxially excised above the sheath, glabrous, glaucous, leathery in texture, obtuse; cauline leaf a linear bract, 1.5–2.5 cm. long. Stem simple, 1-flowered. Outer spathe herbaceous, glaucous, 2.1 cm. long, oblong-elliptic, apically truncate; inner spathe shorter, bifid at the apex. Ovary oblong, 5 mm. long. Perianth-tube 2.3–2.8 cm. long; tepals subequal, the outer series to 1.5 cm. long, 6 mm. wide, ovate, obtuse, deep red-purple on the exterior, greenish on the interior (*in sicco*); the inner series to 1.4 cm. long, 4 mm. wide, elliptic, subobtuse, yellow. Anthers 7 mm. long; filaments not over 5 mm. long. Style 2 cm. long; style-arms at least 7 mm. long, reaching to the middle of the anthers. Capsule and seeds not seen.

CAPE PROV.: Laingsburg Div.: Whitehill, July 31, 1933, *R. H. Compton*, no. 4276 (type, in Bolus Herb., not seen; isotype, K).

In leaves and spathes, this species resembles *H. humilis* Baker, while the flower resembles that of the *lutea*-group, but with a very long perianth-tube. Within its own group of species, however, it is striking, distinct and unmistakable.

H. FLEXUOSA Klatt, Ergänz. 60 (1882); Baker, Handbk. Irid. 148 (1892); Baker in Fl. Cap. vi. 59 (1896), in part.

H. namaquensis Baker, Handbk. Irid. 149 (1892); Baker in Fl. Cap. vi. 60 (1896).

Plant 10–26 cm. tall. Corm small, ovoid-globose, 7–10 mm. wide, the tunics concentric, castaneous or crustaceous, apically short-cusped. Basal leaves 2–3, 5–16 cm. long, basally sheathing, abruptly narrowed above the sheath into the 1–1.5 mm. wide linear-attenuate blade, abruptly acute or obtuse, somewhat falcate, the margins slightly ciliolate for a short distance above the sheath, or glabrous, the midrib thickened; cauline leaf 3–12 cm. long, the 2.5–3.5 cm. sheath somewhat ventricose at base. Stem 1-branched, terete, glabrous, the main axis with a lax, distichous, flexuose, 2–7-flowered spike, the branch 2–3-flowered. Spathes equal or subequal, to 1.3 cm. long, ovate-lanceolate, thin-textured, herbaceous, 9–10-nerved, the apex abruptly acute, the inner spathe hyaline, bicarinate (the nerves green), entire or slightly retuse at the apex. Ovary ovoid to subturbinate, 2–3 mm. long. Perianth-tube 5–8 mm. long, straight, ampliate at the throat; tepals subequal, 8–12 mm. long, 3–4 mm. wide, ovate to obovate, obtuse or subacute, the outer series usually reddish on the exterior, the inner series white. Stamens about as long as the tepals; anthers 5–8 mm. long; filaments 2.5–3 mm. long. Style as long as the perianth-tube; style-arms 5–7 mm. long, much shorter than the anther-apex. Capsule ovoid-ellipsoid, 4 mm. long; seeds (possibly immature) 1 mm., subspherical, dark brown, wrinkled.

CAPE PROV.: LITTLE NAMAQUALAND: without precise data, *Scully*, no. 50 (type of *H. namaquensis*, K); near Elleboogfontein, *Drège*, no. 2639 (TYPE, B); CLANWILLIAM DIV.: Brackdamm, in collibus, 2000 ft. alt., Sept. 8, 1897, *Schlechter*, no. 11125 (K, B, Gen).

On comparison of the types of *H. namaquensis* and *H. flexuosa*, no means of separating them could be found, except that the flowers of the former are said to have been white, while those of the latter are reported to have been red on the exterior of the outer tepals. In the matter of dimensions, there seems to be complete intergradation in the specimens seen.

H. **Galpinii,** spec. nov.

Planta ad 35 cm. alta. Cormus ovoideus, tunicis atrocastaneis, duris, concentricis, ad 1.5 cm. altus et 1.5 cm. latus. Folia basalia 3 (1 cataphyllum), linearia, acuta, erecta, nervo primario marginibusque incrassatis, glabra, ad 30 cm. longa, 2 mm. lata; folia caulina 2, plus minusve spathiformia, 3–6 cm. longa. Caulis simplex, teres, glaber; inflorescentia 1–2-fl. Spathae valva exterior ad 3 cm. longa, lanceolata, acuta, herbacea

sed apice membranacea; valva interior ad 1.9 cm. longa, membranacea, bicarinata, apice plus minusve bifida. Ovarium 4–7 mm. longum, ellipsoideum. Perianthii tubus gracilis, rectus, ad 3 cm. longus; tepala exteriora ad 3.1 cm. longa, 5–6 mm. lata, tepala interiora ad 2.4 cm. longa, ca. 6 mm. lata; flores rosei. Antherae ad 8 mm. longae; filamenta ad 6 mm. longa. Stylus ad 2–2.3 cm. longus, vel longior; styli rami 2.5 cm. longi, antheras excedentes. Capsula seminaque ignota.

CAPE PROV.: BARKLEY EAST DIV.: summit of Doodman's Krans Mt., ca. 9650 ft. alt., Mar. 9, 1904, *Galpin*, no. 6850 (K, B). BASUTOLAND: valley above Buffalo River Waterfall, ca. 8200 ft. alt., Mar. 14, 1904, *Galpin*, no. 6856 (TYPE, K; isotype, B).

In habit, this species is not unlike a small specimen of *H. Baurii* Baker, but it has only one or two large flowers. The perianth-tube of the lower flower is always longer than the spathes; that of the upper flower may be only equal to the spathes, but in the type it is longer.

H. GRAMINIFOLIA Sweet, Hort. Brit. (ed. 1) 399 (1827); Klatt in Linnaea, xxxiv. 649 (1865–66), as to name but probably not as to plant; Baker, Handbk. Irid. 148 (1892) and in Fl. Cap. vi. 59 (1896), as to name but probably not as to plant.

H. pilosa var. β. Ker in Bot. Mag. xxxi. t. 1254 (1810).

Corm not seen. Basal leaves 4, the lowermost a 2–4 cm. cataphyll, mostly subterranean, the 3 produced leaves 7–14 cm. long, 2.5 mm. wide, long-sheathing, linear-falcate, acute, glabrous, the midrib thick; cauline leaf 2–3.5 cm. long, almost entirely sheathing. Stem simple, 14–17 cm. long, terete, glabrous, the inflorescence a lax, secund, 3–9-flowered spike. Outer spathe oblong-ovate, abruptly acute, to 8 mm. long, herbaceous, usually shorter than the perianth-tube; inner spathe to 1 cm. long, longer than the outer spathe, bifid or entire, subherbaceous, bicarinate, usually a little shorter than the perianth-tube. Ovary oblong-ovoid, 2 mm. long. Perianth-tube usually curved from near the base, 6–7 mm. long; tepals subequal, 5–6 mm. long, 2 mm. wide, obovate, obtuse, the outer series with a greenish tinge, the inner series yellowish or white. Anthers 3.5 mm. long; the bases barely exserted from the perianth-tube; filaments 1 mm. long. Style 4 mm. long, much shorter than the perianth-tube; style-arms 3 mm. long. Capsule and seeds not seen.

CAPE PROV.: CAPE DIV.: Kenilworth, near Capetown, 90 ft. alt., September, *H. Bolus*, no. 7246 (K); Wynberg, 100 ft. alt., September, 1892, *Schlechter*, no. 1564 (B).

Since the possibility was advanced earlier that *H. fistulosa* and *H. graminifolia* might be conspecific, although varietally distinct, this description of *H. graminifolia* is included here to illustrate my concept of the species.

H. GRANDIFLORA Lewis in Journ. S. Afr. Bot. vii. 30 (1941).

Acidanthera Tysonii Baker, Handbk. Irid. 187 (1892); Baker in Fl. Cap. vi. 133 (1896).

Plants 25–60 cm. tall. Corm small, globose (*fide* Baker). Basal leaves 2, superposed, long-sheathing, firm, to 50 cm. long and 7 mm. wide, linear, acute, glabrous, the midrib prominent, 2 other ribs subprominent, the edges somewhat thickened; cauline leaf exceeding the inflorescence. Stem simple, terete, glabrous; inflorescence 2–5-flowered, the distant flowers laxly spicate. Outer spathe to 6 cm. long, herbaceous, lanceolate, acute or truncate at the apex; inner spathe to 4.5 cm. long, somewhat membranous. Ovary ovoid to turbinate, to 6 mm. long. Perianth-tube to 3.5 cm. long, slender, cylindrical, becoming abruptly funnel-shaped in the throat, about as long as or slightly longer than the outer spathe; flowers pink, the tepals subequal, to 3.5 cm. long, 1 cm. wide, obovate, obtuse. Anthers slender, linear, to 1.2 cm. long; filaments about as long as the anthers. Style about 3 cm. long; style-arms 2.5 cm. long, equaling the anther-apex. Capsule and seeds not seen.

CAPE PROV.: Griqualand East: Maclear Div.: Drakensberg, on Tsitsa Footpath, 7550 ft. alt., Mar. 20, 1904, *Galpin*, no. 6857 (K); Mt. Currie Div.: near the cataracts on Mt. Currie, 5300 ft. alt., April, 1883, *Tyson in Herb. Norm.*, no. 895 (G).

Although the type of the species, *Tyson*, no. 1151, from Mt. Currie, has not been seen, the two collections cited here, one of them apparently a topotype, were also cited by Miss Lewis when she transferred the species to *Hesperantha*. There is no doubt in my mind as to the correctness of the transfer. Miss Lewis noted (l. c.) that, contrary to the definition of the genus *Hesperantha*, there is considerable variation in the arrangement of the style and stamens, these being often unilateral and arched, instead of central and equilateral. The species has the largest flowers and probably the longest perianth-tube in the genus.

H. **hantamensis** Schlechter in herb., spec. nov.

Cormus ovoideus, 1.5 cm. altus, 1 cm. latus, tunicae imbricatae, crassae, apice longicuspidatae. Folia basalia 4, superposita, longe vaginantia, falcato-recurvata, lamina adaxialiter supra vaginam incisa, textura firma, coriacea, glabra, obtusa vel abrupte acuta, nervus primarius conspicuus, 2–3 nervi inconspicui, margines vix incrassati, ad 3 cm. longa et 6 mm. lata. Caulis praecipue subterraneus, 2–3.5 cm. longus, simplex, 1–3-fl. Spathae valva exterior ventricosa, foliacea, herbacea, 2–2.5 cm. longa; valva interior scariosa, brevior, apice bifida. Ovarium anguste turbinatum, ad 4 mm. longum. Perianthii tubus 2–2.3 cm. longus, apice parum ampliatus, rubro-brunneus; tepala subaequalia, ad 1.1 cm. longa, 3–5 mm. lata, obovata, obtusa vel parum retusa, exteriora rubro-purpurea, interiora pallide luteo-albida. Antherae lineari-sagittatae, ad 7 mm. longae; filamenta ad 4 mm. longa. Stylus ad 2.2–2.3 cm. longus; styli rami ad 5 mm. longi. Capsula seminaque non visa.

CAPE PROV.: Calvinia Div.: Calvinia, northern dolerite hills, 1000 m. alt., August, 1921, *Marloth*, no. 10262 (type, B); Hantam Mts., 1869, *Dr. Meyer*, no. 18 in part (B).

This species is closely related to *H. humilis* Baker, but it can easily be distinguished by the smaller, differently colored flowers, by the different shape of the tepals, and by the four falcate leaves, since *H. humilis* has only three. It is probable that *Meyer*, no. 18, in part belongs here, although the flowers seem to be somewhat larger than those of the type.

H. HUMILIS Baker in Journ. Bot. xiv. 239 (1876); Baker in Journ. Linn. Soc. Bot. xvi. 95 (1877); Klatt, Ergänz. 59 (1882); Baker, Handbk. Irid. 150 (1892); Baker in Fl. Cap. vi. 62 (1896).

Plant 6–12 cm. tall, the corm conic, flat-based, 3.5 cm. wide, 3 cm. high, the tunics imbricate, thick, apically long-cusped, fragmenting upward from the base. Basal leaves 3 (plus a subterranean cataphyll), 6–10 cm. long, 8–10 mm. wide, falcate, obtuse, glaucous, leathery in texture, the midrib and edges thickened. Stem chiefly underground, with a 2–5-flowered inflorescence, this sometimes appearing subcorymbose. Outer spathe to 1.9 cm. long, naviculate or broadly ovate-lanceolate, entire, glaucous, coriaceous; inner spathe scarious, bifid at the apex, bicarinate, to 1.5 cm. long. Ovary more or less ovoid, about 5 mm. long. Perianth-tube 1.2–1.6 cm. long, straight; tepals subequal, the outer series to 2 cm. long, 1 cm. wide, cuneate-obovate, apically retuse, wine-red (darker on the exterior), the inner series slightly shorter, lighter in color, but probably not white. Filaments about 3 mm. long; anthers 3 mm. long. Style nearly 1.5 cm. long; style-arms 8 mm. long, about equaling the anther-apex. Capsule and seeds not seen.

CAPE PROV.: FRASERBURG DIV.: Middle Roggeveld, near Jakhals Fontein, August, 1811, *Burchell*, no. 1320 (TYPE, K); CALVINIA DIV.: Hantam Mts., Rhenosterhoek, 1100 m. alt., September, 1921, *Marloth*, no. 10459 (B); SUTHERLAND DIV.: stony plain toward Waterkloof, 1430 m. alt., September, 1921, *Marloth*, no. 10403 (B).

This description has been included partly because additional material permits some details to be added to the original description and partly to permit comparison with related species here described, such as *H. hantamensis* and *H. flava*.

H. INFLEXA (DelaR.) R. C. Foster in Contrib. Gray Herb. cxxxv. 77 (1941).

Ixia inflexa DelaR. Descr. 15 (1766).

Geissorhiza inflexa (DelaR.) Ker in Koen. & Sims, Ann. Bot. i. 224 (1804); Baker, Handbk. Irid. 157 (1892); Baker in Fl. Cap. vi. 73 (1896), as to name and description but not as to specimens cited.

Geissorhiza vaginata Sweet, Brit. Flow. Gard. ii. t. 138 (1826).

Hesperantha Metelerkampiae L. Bol. in Ann. Bol. Herb. iv. 114 (1927).

Plant 11–32 cm. tall. Corm subglobose, 1.3 cm. high and 1.3 cm. wide; tunics imbricate, apically cusped, basally V-notched, dark brown. Basal leaves 2, to 15 cm. long, 7–8 mm. wide, falcately curved, acute, glabrous, the midrib subprominent; cauline leaves 3, the basal sheaths ventricose,

18–23 cm. long, 9–13 mm. wide, many-nerved. Stem branched shortly above the corm, the main axis branched again in the axil of the second cauline leaf, the axis to 25 cm. tall, terete, glabrous; inflorescence lax, distichous, spicate, each branch 2–3-flowered. Outer spathe to 3 cm. long, carinate, 7-nerved, oblong-acuminate, submembranaceous, hyaline-edged; inner spathe to 2.5 cm. long, membranous, herbaceous along the nerves, bicarinate, entire. Ovary 2–3 mm. long, oblong to turbinate. Perianth-tube 3–5 mm. long, abruptly widened at the throat; outer tepals to 3.4 cm. long, 1.5 cm. wide, unguiculate, obovate, retuse, dull yellow, with the upper third, the midvein, and the lower third dark purple; inner tepals to 3 cm. long, 1.6 cm. wide, obovate-spatulate, unguiculate, retuse, golden yellow, with an apical spatulate blotch and the midvein and basal third dark purple. Anthers 1.4 cm. long, linear, lavender-purple; filaments about 5 mm. long. Style 3–4 mm. long; style-arms 8–9 mm. long, shorter than the anther-apex. Capsule (somewhat immature) 5 mm. long, turbinate; mature seeds not seen.

CAPE PROV.: Calvinia Div.: Hantam Mts., 1869, *Dr. Meyer*, no. 1 (B); Nieuwoudtville, Aug. 12, 1931 *Ross-Frames* (K).

With a very short perianth-tube and imbricate corm-tunics, this species has the aspect of a *Geissorhiza*, but the short style, not exserted from the perianth-tube, and the long style-arms show that it is a *Hesperantha*. Although the type of *Ixia inflexa* may no longer be in existence, De la Roche's description is quite clear and leaves no doubt that his plant is conspecific with *Geissorhiza vaginata* Sweet and *H. Metelerkampiae* L. Bol. The type of the latter species has not been seen, but topotype material sent by the Bolus Herbarium to Kew makes the identification certain. In color, it is the most striking plant in the genus.

H. inflexa var. **Stanfordiae** (L. Bol.), comb. nov.

H. Stanfordiae L. Bol. in S. Afr. Gard. xxi. 281 (1931).

Plant to 25 cm. tall. Corm subglobose, 1.2 cm. wide, 1 cm. high, the tunics imbricate, apically short-cusped. Basal leaves 3, falcate, subacute, glabrous, the midrib prominent, 10–40 cm. long, 4–8 mm. wide, the bases long-sheathing; cauline leaves 2, ventricosely sheathing, 12–20 cm. long. Stem branched, main axis to 23 cm. long, terete, glabrous, axis and branches 2-flowered. Outer spathe linear-oblong, subacuminate, herbaceous, to 2 cm. long; inner spathe 1.7 cm. long, more or less hyaline, bicarinate, the nerves green, almost entire. Ovary 4 mm. long, subturbinate. Perianth-tube 2.5 mm. long, abruptly widened at the throat; tepals subequal, to 2.7 cm. long, 1.2 cm. wide, obovate, shortly unguiculate, clear golden yellow. Anthers 1 cm. long, linear-sagittate, yellow; filaments about 3 mm. long. Style to 4 mm. long; style-arms to 8 mm. long, shorter than the anther-apex. Capsule oblong to subturbinate, to 1.1 cm. long; mature seeds not seen.

CAPE PROV.: Calvinia Div.: Nieuwoudtville, September, 1931, *H. Buhr* (Nat. Bot. Gards. no. 837/30) (K); Nieuwoudtville, at first gate on Lerisfontein Road, just outside of town, September, 1930, *L. Bolus* (Nat. Bot. Gards. no. 1580/30) (K).

Although the type of *H. Stanfordiae* L. Bol. has not been seen, two topotypes, sent to Kew by the Bolus Herbarium, have been available. This beautiful plant seems a clear yellow fewer-flowered state of *H. inflexa*, and accordingly is here reduced to varietal status.

H. longicollis Baker in Bull. Herb. Boiss. (II) iv. 1004 (1904).
H. matopensis L. S. Gibbs in Journ. Linn. Soc. xxxvii. 471 (1906).

Plant about 40 cm. tall. Corm more or less conic, the tunics thick, apically short-cusped, the basal edges irregularly frayed and serrate with 2–3 sharp cusps, to 1.2 cm. high and 1 cm. wide. Basal leaves 3–4, 7–30 cm. long, 1.5–2 mm. wide, linear, acute, glabrous, the midrib and edges thickened; cauline leaf to 6 cm. long, mostly sheathing. Stem simple, subterete, glabrous, exceeding the leaves, with a simple, rather lax, 3–6-flowered, secund spike. Outer spathes basally united around the stem for about 7 mm., this union tending to break as the flower matures, to 2.3 cm. long, ovate-lanceolate, entire or emarginate at the apex, glaucous, ca. 7-nerved; inner spathe to 2.1 cm. long, 4-nerved, green-membranous, somewhat bifid at the apex. Ovary turbinate, 4–5 mm. long. Perianth-tube to 2.5 cm. long, strongly curved so that the flower opens downward; tepals strongly reflexed, the outer to 1.5 cm. long, 3 mm. wide, elliptic, long-acute, reddish-brown, the margins undulate; inner tepals to 1.3 cm. long, yellowish or white. Anthers to 8 mm. long; filaments to 5 mm. long. Style ca. 2.5 cm. long, hardly exserted from the perianth-tube; style-arms 1–1.2 cm. long. Mature capsule and seeds not seen.

SOUTHERN RHODESIA: Matopo Hills, sandy banks of the Malami River, 4500 ft. alt., September, 1905, *L. S. Gibbs*, no. 44 (type of *H. matopensis*, in Herb. Brit. Mus., not seen; photo, G). TRANSVAAL: Modderfontein, Oct. 11, 1898, *Conrath*, no. 600 (type, K); Klippstaapel bei Ermeloo, Oct. 18, 1888, *Wilms*, no. 1513 (B). NATAL: Estcourt: Cathkin Park, Drakensberg, summit of Little Berg, 6000 ft. alt., Feb. 25, 1932, *Galpin*, no. 11768 (K).

Although I have not seen the type of *H. matopensis*, an excellent photograph of it has been secured through the kindness of Dr. John Ramsbottom. It is a close habital match for *Wilms*, no. 1513, and, with the careful, detailed original description, leads me to place the plant, at least for the time being, in the synonymy of *H. longicollis*. The Natal specimen cited, *Galpin*, no. 11768, is rather intermediate between *H. longicollis* and *H. radiata*, but appears to me to be closer to the former.

H. LONGITUBA (Klatt) Baker in Gard. Chron. 1877 (I): 652; Baker in Journ. Linn. Soc. Bot. xvi. 96 (1877); Klatt, Ergänz. 60 (1882); Baker, Handbk. Irid. 151 (1892); Baker in Fl. Cap. vi. 64 (1896).

Geissorhiza longituba Klatt in Linnaea, xxxv. 383 (1867–68).

Acidanthera Huttonii Baker in Journ. Bot. xiv. 339 (1876).

Plant 8–28 cm. tall. Corm ovoid-globose, the tunics apparently concentric. Basal leaves 2–3, to 25 cm. long, 4–12 mm. wide, lax, falcate, glabrous; cauline leaves 1–2, 2.5–4.5 cm. long, mostly sheathing. Stem simple or 1-branched shortly above the base, terete, glabrous; inflorescence a 3–4-flowered distichous spike. Outer spathe to 2.3 cm. long, oblong-ovate, obtuse, rather thin-textured, 7–9-veined, herbaceous but membranous at the apex; inner spathe 1.2–1.8 cm. long, membranous, bicarinate, bifid at the apex. Ovary 3–8 mm. long, turbinate, short-pedicellate. Perianth-tube straight, 2–2.4 cm. long, slender; outer tepals 1.8–2.1 cm. long, 7 mm. wide, ovate, acute, red-flushed on the exterior; inner tepals 1.5–1.8 cm. long, 7–8 mm. wide, ovate, acute, white. Anthers to 1 cm. long, three-fourths the length of the tepals; filaments to 5 mm. long. Style to 2.2 cm. long; style-arms 1–1.5 cm. long, about three-fourths the length of the anthers. Mature capsule and seeds not seen.

CAPE PROV.: ALBERT DIV. (?): from the north base of Stormbergen to Buffelvallei on the Gariep, 4000–5000 ft. alt., September, *Ecklon & Zeyher*, Irid. no. 220 (Gen, B); MURRAYSBURG DIV.: northwest side of Koudeveld Mt., near Murraysburg, 5000 ft. alt., September, *MacOwan*, no. 61 in part (K, Gen); SOMERSET EAST DIV.: *Bowker* (TYPE, K); near the Boschberg, *MacOwan*, no. 61 in part (K, Gen); ALBANY DIV.: Alicedale, July 24, 1908, *F. A. Rogers*, no. 3586 (B).

I have seen no material of *Acidanthera Huttonii* and have placed it in synonymy following Miss G. J. Lewis in Journ. S. Afr. Bot. vii. 30 (1941). Miss Lewis reports that "A specimen in the National Herbarium [*Galpin*, no. 2067] from the type locality, Katberg, named *A. Huttoni* by N. E. Brown, was examined. The material is very poor, but the flower has three long style branches arising from the throat of the perianth-tube."

There is at Kew a specimen from the Leichtlin gardens, from which Baker seems to have drawn his description in the Gardener's Chronicle where the transfer from *Geissorhiza* to *Hesperantha* was made. This was marked by N. E. Brown as the type-specimen, but that is impossible; the type is the Bowker collection, one of the two cited by Klatt in his original description. The other specimen cited by Klatt, *Cooper*, no. 746, was later made the type of *H. candida* Baker.

H. LUTEA var. **luculenta,** var. nov.

A speciei tubi longitudine (1 cm.) et floris colore differt.

CAPE PROV.: PIQUETBERG DIV.: in collibus ad flumen Berg Rivier prope Piquetberg, 60 m. alt., Apr. 10, 1894, *Schlechter*, no. 5621 (TYPE, G; isotypes, K, B, Gen); MALMESBURY DIV.: between Moorreesburg and Piquetberg, Aug. 19, 1932, *L. Bolus* (Nat. Bot. Gards. no. 1825/32) (K).

This variety differs from the species chiefly in the length of the perianth-tube and in the clear yellow color of the flower, although the specimen collected by Dr. Louisa Bolus has some darker color on the exterior of the outer tepals. There seems to be no essential difference in corm and leaves, although the leaves of the variety may be a little longer than is usual in the species.

H. **Marlothii,** spec. nov.

Cormus ovoideo-conicus, 1 cm. latus et 1.2 cm. altus, basi percomplanatus, tunicae imbricatae, basi leviter incisae. Folia plerumque 4, superposita, 5–10 cm. longa, 2 mm. lata, basi vaginantia, infra linearia supra teretia, attenuata, glabra, nervus primarius incrassatus. Caulis simplex, teres, glaber, 13–19 cm. longus; inflorescentia spica laxa, secunda, subflexuosa, 2–4-fl. Spathae valva exterior ad 1.8 cm. longa, margines circum caulem 1 mm. coaliti, lanceolata, acuta, herbacea; valva interior subaequalis, membranacea, bicarinata, subbifida. Ovarium turbinatum, 3–6 mm. longum. Perianthii tubus ad 1.1 cm. longus, ad apicem curvatus, flos nutans; tepala patentia, exteriora ad 1.1 cm. longa et 2 mm. lata, anguste oblongo-lanceolata, subacuta, rubro-brunnea, margines lutei; tepala interiora ad 9 mm. longa, 3 mm. lata, oblongo-obovata, obtusa, lutea. Antherae ad 7 mm. longae; filamenta ca. 3.5 mm. longa. Stylus perianthii tubum aequans; styli rami ad 5 (raro 6) mm. longi. Capsula (immatura ?) 6 mm. longa, turbinata; semina 1 mm. diam., subglobosa.

CAPE PROV.: SUTHERLAND DIV.: Sutherland, stony plain toward Waterkloof, 1430 m. alt., September, 1921, *Marloth*, no. 10412 (TYPE, B); CALVINIA DIV.: Oorlogskloof, 2300 ft. alt., Aug. 21, 1897, *Schlechter*, no. 10946 (B).

This species differs from *H. radiata* in its corm which has shallow rounded basal indentations, separated by sharp projections, rather than completely and irregularly serrate, in its rather fistulose subterete leaves, and in the flower-color.

H. MINIMA (Baker) R. C. Foster in Contrib. Gray Herb. cxxxv. 77 (1941).

Geissorhiza minima Baker in Journ. Bot. xiv. 239 (1876); Baker, Handbk. Irid. 159 (1892); Baker in Fl. Cap. vi. 75 (1896).

Corm unknown. Plant about 7.5 cm. high. Basal leaves usually 3, filiform-subulate, falcate, glabrous, acute, to 6 cm. long, 0.5 mm. wide; cauline leaf to 2 cm. long, sheathing at the base. Stem simple or branched, filiform, glabrous; inflorescence 1–3-flowered. Outer spathe 3–4 mm. long, ovate-lanceolate, herbaceous at the base, the upper third brown-mem-

branous, obtuse, entire, shorter than the perianth-tube; inner spathe nearly as long as the outer, membranous, bicarinate. Perianth-tube to 6 mm. long; outer tepals 5 mm. long, about 1 mm. wide, narrowly elliptic, subacute, whitish, red on the exterior; inner tepals 4 mm. long, about 1 mm. wide, white. Anthers 1.5 mm. long, a little over half the length of the tepals; filaments 1.5 mm. long. Style 4.5–6 mm. long; style-arms 4 mm. long. Capsule and seeds not seen.

CAPE PROV.: LITTLE NAMAQUALAND: mountains near Modderfontein, 4000–5000 ft. alt., *Drège*, no. 2632 (TYPE, K; isotypes, Gen, B).

This fragile dwarf species, known only from the type-collection, was described by Baker in *Geissorhiza*, with the statement that the style-branches were short, the implication being that they were enough shorter than the style to warrant inclusion in that genus. Dissection shows, however, that the style is not exserted from the perianth-tube, and that the style-arms are at least two-thirds as long as the style. For that reason, the transfer to *Hesperantha* was made.

H. **Pearsonii,** spec. nov.

Cormus ovoideo-conicus, basi complanatus, tunicae imbricatae, basi serratae, 1.4 cm. altus, 1 cm. latus. Folia basalia 4, superposita, ad 10 cm. longa, 4 mm. lata, lineari-falcata, obtusa, glabra, basi vaginantia, supremum cum vagina ventricosa, nervus primarius margines et nervii alii 2 incrassati. Caulis simplex vel 2-ramosus e basi, 3–26 cm. altus, teres, glaber, plerumque subterraneus; inflorescentia 1-fl. Spathae plerumque in vagina folii supremi occultae, exterior ad 1.3 cm. longa, interior subaequalis, lanceolato-ovata, acuta, plus minusve herbacea, interior scariosa, bicarinata, subbifida. Ovarium ad 3 mm. longum, oblongo-turbinatum. Perianthii tubus ad 1.8 cm. longus, quam tepala pallidior (in sicco), apice ampliatus; tepala subaequalia ad 1.8–2 cm. longa, 3–4 mm. lata, anguste ovata, acuta, rubro-purpurea. Stylus quam tubus subbrevior; styli rami ad 1.4 cm. longi, antherarum apicem plerumque aequans. Antherae ad 4 mm. longae; filamenta ad 7 mm. longa. Capsula turbinata, ad 8 mm. longa; semina complanato-globosa, 1 mm. diam.

CAPE PROV.: LITTLE NAMAQUALAND: Khamsoap Ravine in the Khamiesberg Mts., dry stream-side, Sept. 15, 1911, *Pearson*, no. 6539 (TYPE, B); without definite locality or date, *Schlechter*, no. 11221 (B).

Of the nine individuals seen, one is much larger than the others in its vegetative parts. It is possible that it was located nearer to a water-supply than the others, thus accounting for its increased growth.

H. PENTHERI Baker in Kew Bull. 1906: 26.
Geissorhiza pauciflora Baker in Bull. Herb. Boiss. (II) iv. 1004 (1904).
Hesperantha insipida Lewis in Journ. S. Afr. Bot. vii. 56 (1941).

Plant 6–18 cm. tall. Corm conic to subglobose, to 7 mm. wide, 8 mm. high, basally flattened, tunics imbricate, crustaceous, dark brown, apically cusped, basally fringed or serrate. Basal leaves 2, 2.5–11 cm. long, 1–3 mm. wide, linear, acute, recurved, glabrous, edges and midrib thickened, 4 other nerves prominent; cauline leaf 4–10 cm. long, long-sheathing, the sheath somewhat ventricose at the base. Stem simple, terete, glabrous, with a 1–2-flowered inflorescence. Outer spathe to 1.4 cm. long, usually shorter, oblong-ovate, subacute or obtuse and slightly emarginate, herbaceous, thin-textured, about 15-nerved; inner spathe as long or slightly shorter, membranous, bicarinate, bifid at the apex. Ovary 2–6 mm. long, turbinate. Perianth-tube to 1.3 cm. long, longer than the spathes; outer tepals to 1.5 cm. long, 3 mm. wide, elliptic-obovate, subacute, striate and flushed with red-purple on the exterior; inner series to 1.3 cm. long, creamy yellow or white, sometimes tinged with yellow-green. Anthers 4 mm. long; filaments about as long. Style ca. 1 cm. long; style-arms 9–10 mm. long, slightly exceeding the anther-apex. Capsule and seeds not seen.

CAPE PROV.: Clanwilliam Div.: Olifants River, August, 1894, *Penther*, no. 686 (type, K); Bosch Kloof, 800 ft. alt., Aug. 9, 1896, *Schlechter*, no. 8459 (K, B, Gen); Piquetberg Div.: near Porterville, 320 m. alt., Aug. 19, 1894, *Schlechter*, no. 4891 (type-number of *Geissorhiza pauciflora*, K, B, Gen); Porterville, 600 ft. alt., Aug. 5, 1897, *Schlechter*, no. 10742 (K, B, Gen).

Because of the presence of *H. pauciflora* (Baker) Lewis, based on *Tritonia pauciflora* Baker, it is impossible to transfer *G. pauciflora* Baker to *Hesperantha*. For that reason, Miss Lewis renamed this species *H. insipida*. Comparison of the types of *G. pauciflora* and *H. Pentheri* shows them to be conspecific, and the latter name has precedence over *H. insipida*.

H. Petitiana (A. Rich.) Baker, var. **Volkensii** (Harms), comb. nov.
H. Volkensii Harms in Engler, Bot. Jahrb. xix (Beibl. 47). 28 (1894).

After studying a considerable series of specimens purporting to be *H. Volkensii* (including an isotype, *Volkens*, no. 783) and *H. Petitiana*, I have reached the conclusion that the two are far too close to be maintained as separate species. In fact, if there were not apparently a tendency for material from Abyssinia to have rather smaller flowers and shorter anthers than material from Uganda, Nyassaland, and Tanganyika, I should hesitate to retain *H. Volkensii* even in varietal status.

H. **puberula** Schlechter in herb., spec. nov.
Cormus ovoideus, ca. 8 mm. latus, 1 cm. altus, tunicae crustaceae, pallide brunneae, apice cuspidatae, concentricae. Folia quasi basalia, superposita, infimum cataphyllum scariosum ad 4 cm. longum, alia producta, ad 18 cm. longa, 1–2 mm. lata, linearia, acuta, plurinervata,

margines et nervii primarii crassi et dense pubescentes. Caulis simplex, teres, glaber, 7–22 cm. longus; inflorescentia 1–4-fl., spica laxa, disticha plerumque 2-fl. Spathae subaequales, ad 1.1 cm. longae, interior parum brevior, exterior oblongo-ovata, herbacea, apice obtusa, retusa, interior membranacea, bicarinata, bifida. Ovarium ad 3 mm. longum, ellipsoideum. Perianthii tubus ad 7 mm. longus, rectus; tepala concoloria, atropurpurea, exteriora ad 1.6 mm. longa, 3 mm. lata, elliptico-ovata, acuta, interiora ad 1.4 cm. longa, 4 mm. lata, acuta. Antherae ad 6 mm. ongae; filamenta ca. 2 mm. longa. Stylus ad 5–6 mm. longus; styli rami 8–9 mm. longi. Capsula immatura 5 mm. longa, subturbinata; semina non visa.

CAPE PROV.: Calvinia Div.: Onder-Bokkeveld, Oorlogskloof, 2200 ft. alt., Aug. 21, 1897, *Schlechter*, no. 10952 (type, B; isotypes, K, Gen).

Clearly related to *H. pilosa* (L. f.) Ker, this species differs from it chiefly in its flower-color and -size, and its long perianth-tube.

H. **rupestris** N. E. Br. in herb., spec. nov.

Cormus ignotus. Planta 44–50 cm. alta. Folia basalia 2, 22–47 cm. longa, 2 mm. lata, linearia, glabra, acuta, nervus primarius marginesque incrassati; folia caulina 2, inferius 17–31 cm. longum, superius maxime reductum (vagina 2 cm. longa). Caulis simplex, teres, glaber; inflorescentia spica laxa, disticha, 6–8-fl. Spathae valva exterior ad 1.2 cm. longa, oblongo-ovata, subacuta, 7-nervata, carinata, herbacea, apex marginesque membranacei; valva interior ad 8 mm. longa, hyalina, bicarinata, apice subemarginata. Ovarium ca. 3 mm. longum, oblongo-ovoideum. Perianthii tubus 7 mm. longus, rectus; tepala subaequalia, ad 1.4 cm. longa, 2.5–3 mm. lata, elliptica, subacuta, exteriora rubro-purpurea striata et suffusa, interiora alba. Antherae ca. 6 mm. longae; filamenta 3 mm. longa. Stylus ca. 6 mm. longus, quam tubus brevior; styli rami ca. 1 cm. longi, antherarum apices paene aequantes. Capsula matura seminaque non visa.

TRANSVAAL: among rocks at Waterval Boven, Mar. 29, 1929, *Mrs. M. Moss in Herb. Moss*, no. 17314 (type, K).

H. **sabiensis** N. E. Br. in herb., spec. nov.

Cormus ignotus. Folia plus minusve 4–5, basalia vel arcte superposita, et 3 caulina, ad 25 cm. longa, 3 mm. lata, glabra, lineari-attenuata, acuta, nervo primario conspicuo, basi bulbillifera. Caulis simplex, teres, glaber, folia excedens, 4-fl. Spathae valva exterior ca. 1.8 cm. longa, anguste lanceolata, acuta, plurinervata, margine plus minusve hyalina; valva interior ad 1.5 cm. longa, 2-nervata, integra, tenuiter membranacea. Ovarium ad 4 mm. longum, anguste oblongo-turbinatum. Perianthii tubus apice valde curvatus, ad 2 cm. longus; tepala subaequalia, ad 1.6 cm. longa, 4.5 mm. lata, lanceolato-ovata, obtusa vel haud retusa, alba (?). Antherae 7 mm. longae; filamenta 7 mm. longa. Stylus perianthii tubum subaequans; styli rami ca. 1.3 cm. longi. Capsula seminaque non visa.

TRANSVAAL: Lydenburg Distr.: Sabie, July, 1917, *Cunliffe in Herb. Moss*, no. 4311 (type, K).

The affinities of this species are with *H. bulbifera*, but the latter has a tube shorter than the tepals, and fewer broad lax leaves, while this species has the tube longer than the tepals and more numerous narrow leaves.

H. **semipatula,** spec. nov.

Planta 7–14 cm. alta. Cormus ovoideo-globosus, ca. 5 mm. latus, 7 mm. altus, tunicis concentricis, atrobrunneis, apice breve cuspidatis. Folia basalia 3, 3–9 cm. longa, 1–1.5 mm. lata, linearia, subrecurvata, glabra, apice acuta vel obtusa, nervus primarius marginesque incrassati; folia caulina nulla. Caulis simplex, teres, glaber; inflorescentia spica laxa, disticha, 1–3-fl. Spathae valvae exteriores 9–10 mm. longae, oblongae, subacuminatae, 9-nervatae, herbaceae, tenues, apices emarginatae; valvae interiores 7–8 mm. longae, membranaceae, bicarinatae (nervis viridibus), apice bifidae. Ovarium oblongum vel subturbinatum, 4–6 mm. longum. Perianthii tubus 4–6 mm. longus, rectus, angustus; tepala exteriora ad 1.2 cm. longa, 2.5 mm. lata, elliptico-ovata, subacuta; interiora ad 1 cm. longa, 3 mm. lata, obtusiora, pallidiora. Antherae 3–4 mm. longae; filamenta 3.5–5 mm. longa. Stylus 3.5–5.5 mm. longus, quam tubus brevior; styli rami ad 6–7 mm. longi, antheras aequantes vel excedentes. Capsula seminaque non visa.

CAPE PROV.: Clanwilliam Div.: Vogelfontein, 1200 ft. alt., Aug. 19, 1896, *Schlechter*, no. 8521 (type, K; isotypes, B, Gen).

Superficially, this species suggests *H. Pentheri*, but that has several conspicuous nerves in the leaves instead of one, and its corm-tunics are imbricate, not concentric, with very ragged bases. The color of the flower of *H. semipatula* is doubtful, but it is probably white, with the outer tepals at least faintly purple-flushed on the exterior.

H. **similis** N. E. Br. in herb., spec. nov.

Planta 20–40 cm. alta. Cormus ignotus. Folia basalia 4–5, 6–38 cm. longa, 1–2 mm. lata, nervus primarius marginesque incrassati, linearia, acuta, glabra; folia caulina 1–2, reducta, 2.5–5 cm. longa, vaginantia. Caulis simplex, teres, glaber; inflorescentia spica laxa, disticha, 2–6-fl., rhachis flexuosa. Spathae valvae subaequales, ad 1.4 cm. longae, exterior 9–11-nervata, herbacea, carinata, oblongo-ovata, subobtusa; interior vix brevior, hyalina, bicarinata, apice bifida. Ovarium 4–6 mm. longum, ovoideum vel turbinatum. Perianthii tubus 5–6 mm. longus, rectus; tepala subaequalia, obovata, ad 1.4 cm. longa, 5 mm. lata, obtusa, integra, pallide rosea. Antherae 5 mm. longae; filamenta 3–4 mm. longa. Stylus 4–5 mm. longus; styli rami 1.1 cm. longi, antheras aequantes vel excedentes. Capsula seminaque non visa.

TRANSVAAL: Lydenburg Distr.: Devil's Knockels, near the city of Lydenburg, April, 1887, *Wilms*, no. 1446 (type, K; isotype, B).

In appearance, this plant is not unlike the Nyassaland plants of *H. Petitiana* var. *Volkensii*, but with laxer leaves and flexuose rhachis.

H. SPICATA (Burm. f.) N. E. Br. in Kew Bull. 1929: 136.
Ixia spicata Burm. f. Prodr. 1* (1768).

Corm ovoid-conic, flat-based, to 2 cm. wide, 2 cm. high; tunics imbricate, finely and irregularly serrate at the base, shiny chestnut-brown. Basal leaves 3, the lowest a semi-membranous bluntly pointed sheath 1.3–4 cm. long, the others ensiform to subfalcate, obtusely rounded at the apex, firm-textured, glabrous, the midrib prominent, the edges with a pellucid short-ciliolate fringe, to 19 cm. long, but usually much shorter, 5 mm. wide; cauline leaves 2, 2.5–12 cm. long. Stem simple, terete, glabrous, becoming purple-tinged below the inflorescence, to 38 cm. long, bearing a semi-lax, secund, 4–7-flowered spike. Outer spathe to 8 mm. long, broadly ovate, green, 10-nerved; inner spathe 7 mm. long, hyaline, bi-carinate (the nerves green), bifid at the apex. Ovary more or less trigonal, 2.5 mm. long. Perianth-tube nearly 5 mm. long, curved from the base; outer tepals to 6 mm. long, 2 mm. wide, ovate-oblong, reddish on the exterior; inner tepals about 4 mm. long, 2 mm. wide, light yellow or white. Anthers 4 mm. long; filaments 2.5 mm. long. Style 3 mm. long, shorter than the perianth-tube; style-arms about 4 mm. long, much shorter than the anther-apex. Mature capsule and seeds not seen.

CAPE PROV.: without definite locality, *Burmann f.* (TYPE, Gen); MALMESBURY DIV.: Enkelde Valei near Hopefield, mid-August, 1887, *Bachmann*, no. 1977 (B); TULBAGH DIV.?: Kluitjes Kraal, near Ceres Road, 650 ft. alt., August, 1888, *Tyson in Herb. Austr.-Afr.*, no. 1540 (G, B, Gen).

The typical variety, with straight-edges rather than undulate-edged leaves, is apparently much less frequent than the following variety.

H. SPICATA var. **cinnamomea** (L. f.), comb. nov.
Ixia cinnamomea L. f. Suppl. 92 (1781).
Hesperantha cinnamomea (L. f.) Ker in Koen. & Sims, Ann. Bot. i. 225 (1804), and all subsequent authors, at least as to name.

The variety differs from the species chiefly in its often shorter and undulate-edged leaves, a character in which there is a certain amount of intergradation with the species.

CAPE PROV.: without definite locality, *Dr. Pappe* (K); PIQUETBERG DIV.: near Piquetberg Road, 400 ft. alt., Aug. 17, 1894, *Schlechter*, no. 4852 (K, B, Gen); MALMESBURY DIV.: Darling, August, 1883, *Bachmann*, no. 385 (B); between Moorreesburg and Piquetberg, Aug. 19, 1932, *L. Bolus* (Nat. Bot. Gards. no. 1826/32); CAPE DIV.: Rosebank, near Capetown, 1877, *H. Bolus*, no. 3768 (K); east base of Lion's Head, Capetown, Aug. 24, 1900, *Diels*, no. 68 (B); Green Point, Aug. 19, 1846, *Prior* (K); Table Mt., 600 ft. alt., September, 1908, *R. Dümmer*, no. 44C (G).

With the exception of Dr. Pappe's specimens, no material without definite locality has been cited, although several have been seen. The exception has been made because on that sheet N. E. Brown made the following note: "Compared with the type [of *Ixia spicata*] in Burm's. Herb. now in Geneva, July, 1928. Burm's. plant is this sp! but it is a spec. with entire (not wavy) lvs. which are broadly linear and longer than these, about 4 in. long and 3–3½ lines broad. It is a cultivated specimen." Although I have not seen the type nor a photograph of the type of *Ixia cinnamomea*, I have been much aided by a note made by N. E. Brown on *H. Bolus*, no. 3768, indicating that he had compared it with the type of *I. cinnamomea*.

H. **trifolia,** spec. nov.

Planta 10–24 cm. alta. Cormus conicus vel subglobosus, basi complanatus, ad 1.3 cm. altus, 1.3 cm. latus; tunicae imbricatae, apice breve cuspidatae, basi irregulariter serratae, durae, atrobrunneae. Folia basalia 3, 5–18 cm. longa, 5–8 mm. lata, tenuia, falcata, glauca, obtusa vel subapiculata, margines nervus primarius et nervii alii 2 conspicui; folia caulina 1–2, 5–9 cm. longa, 6–8 mm. lata, semivaginantia, vagina subventricosa. Caulis 1–2-ramosus, ad 16 cm. longus sed plerumque ca. 10 cm., teres, glaber; inflorescentia spica laxa, disticha, flexuosa, 1–6-fl. Spathae valva exterior ad 1.5 cm. longa, ovato-lanceolata vel oblongo-ovata, obtusa vel subtrilobulata, herbacea, margines membranacei, carinata, 9–11-nervata; valva interior subaequalis, scariosa, bicarinata, bifida. Ovarium 2–5 mm. longum, turbinatum. Perianthii tubus ad 1 cm. longus, angustus, apice ampliatus; tepala subaequalia, ad 1.7 cm. longa, 4–4.5 mm. lata, ovata vel obovata, obtusa, exteriora extus rubro- vel pallide rubro-suffusa, interiora alba, parum retusa. Antherae ad 6.5 mm. longae; filamenta 5 mm. longa. Stylus 7–8 mm. longus; styli rami ad 1.2 cm. longi. Capsula immatura ad 6 mm. longa; semina non visa.

CAPE PROV.: Clanwilliam Div.: Bull Hoek, 600 ft. alt., Aug. 2, 1896, *Schlechter*, no. 8378 (type, B; isotypes, K, Gen); Olifants River Valley, 6 miles from Clanwilliam, Aug. 20, 1932, *L. Bolus* (Nat. Bot. Gards. no. 1918/32) (K).

This species is much like *H. cucullata* in general aspect, but the corm-tunics are imbricate and basally frayed and irregularly serrate-fringed, the leaves are three in number, and the blades of the cauline leaves are not turned at a sharp angle from the stem.

H. **Tugwellae,** spec. nov.

Cormus conicus, ad 1.2 cm. altus, 1.5 cm. latus, tunicae concentricae. Folia basalia 3, ad 20 cm. longa, 3–4 mm. lata, linearia, subfalcata, acuta, glabra, nervus primarius et margines incrassati; folia caulina 1–2, 4–9.5 cm. longa, longe vaginantia. Caulis simplex, teres, glaber, ad 20 cm. longus; inflorescentia spica laxa, disticha, 1–8-fl. Spathae valva exterior

ad 2 cm. longa, lanceolato-ovata, herbacea, apice membranacea, obtusa vel subretusa; spathae valva interior ad 1.7 cm. longa, membranacea, bicarinata, apice subbifida. Ovarium subturbinatum, ad 4.5 mm. longum. Perianthii tubus rectus, ad 1.6 cm. longus, luteus; tepala exteriora ad 2 cm. longa, 8 mm. lata, elliptico-ovata, obtusa vel subacuta, extus brunneo-purpurea, plerumque marginibus luteis; tepala interiora ad 1.7 cm. longa et ca. 8 mm. lata, elliptica, acuta, lutea. Antherae ad 1 cm. longae, subapiculatae; filamenta ca. 5 mm. longa. Stylus ad 1.8 cm. longus; styli rami ad 1 cm. longi. Capsula immatura ad 8 mm. longa, turbinata; semina non visa.

CAPE PROV.: Prince Albert Div.: Prince Albert, July 19, 1929, *Mrs. A. M. Tugwell* (Nat. Bot. Gards. no. 1151/29) (type, K); Prince Albert, 650 m. alt., August, 1921, *Marloth*, no. 10311 (B); Uniondale Div.: rocky hill north of Joubertina, 2000 ft. alt., August, 1923, *Fourcade*, no. 2690 (K).

Related to *H. lutea*, *H. Tugwellae* differs in the following points: the corm-tunics are imbricate but the segments are not markedly frayed at the base, the leaves are rather longer, less thick-textured, and few-veined, the spathes are longer and the perianth-tube much exceeds the spathes.

H. Widmeri Beauv. in Bull. Herb. Boiss. (II) v. 990 (1905), cum ic.

Corm not seen (stated to be small). Basal leaves probably about 3, 30–40 cm. long, 1–1.5 mm. wide, very lax, forming a tangled mat; cauline 20–25 cm. long. Stem simple, terete, glabrous, 28–46 cm. long, with a very lax 3–4-flowered distichous spike. Outer spathes to 2.5 cm. long, barely or not at all united around the stem at their base; inner spathes 1.2–1.5 cm. long, membranous, bicarinate, slightly bifid at the apex. Ovary subturbinate, 3 mm. long. Perianth-tube to 2.3 cm. long, strongly curved at the top, with the flower pointing downward; tepals subequal, to 1.8 cm. long, 3 mm. wide, elliptic-obovate, subobtuse, the outer series brown-purple, yellow-margined, the inner series yellow. Anthers 7–8 mm. long; filaments 5–6 mm. long. Style as long as the perianth-tube; style-arms 10–12 mm. long. Mature capsule and seeds not seen.

TRANSVAAL: mountains near Johannesburg, August, 1905, *Widmer* (type, Gen, not seen; photo, G); Koedoes-poort, Pretoria, Aug. 1, 1905, *L. Reck in Herb. Burtt-Davy*, no. 926 (K).

The description given above has been made from the original description, study of a beautifully clear life-sized photograph of the type, received through the kindness of Professor Hochreutiner, and from the one collection available to me. It is, I think, quite distinct from *H. longicollis*. The latter has more numerous, more approximate and smaller flowers, with shorter and not tangled leaves, and the outer spathes well-united around the stem at their bases.

2. STUDIES IN THE FLORA OF BOLIVIA,—II.

Iridaceae, Part 2.

This postponed study of the Bolivian species of *Sisyrinchium* is, of necessity, unsatisfactory in several respects. Like Johnston, in his excellent treatment of the species of northern Argentina, Paraguay, Uruguay and Brazil (see Journ. Arn. Arb. xix. 376–401 [1938]), I have found it necessary to evade the question of the *vaginatum*-complex. Binomials have been used for species which are "good", if sometimes too broadly conceived, but until certain European types can be restudied, uncertainty must exist as to the correct application of such names as *S. vaginatum*, *S. micranthum* and *S. junceum*. *S. Marchio*, as treated here, will almost certainly be divided when the whole variable complex can be studied. Again, *S. azureum* seems a valid species, but until Philippi's type can be restudied, the possibility of an incorrect application of the name must remain. In the case of *S. Marchio* and *S. azureum*, I have followed Johnston's concepts, as shown by specimens so annotated by him. It may be, too, that additional material of species now poorly represented will show that in some instances specific lines have been drawn too narrowly.

To Mr. E. P. Killip, who lent all Bolivian material in the United States National Herbarium (US), I am much indebted. To go through extensive South American collections, removing only Bolivian sheets, is a time-consuming task, and I deeply appreciate his kindness in undertaking it.

SISYRINCHIUM L.

More or less caespitose perennial or annual herbs, the rhizomes usually short or obsolete. Leaves mostly in an obvious basal cluster, but this sometimes lacking and the cauline leaves then more numerous and well-developed. Spathes terminal on simple or branched stems, sometimes appearing lateral when a terminal cauline leaf is present, one- to several-flowered. Perianth-tube absent but tepals basally united, the flowers rotate. Filaments from partially to almost completely united, the tube variously glandular or villous or glabrous; anthers from small and approximate to large and divergent. Style at least as long as the stamen-tube; style-arms from minute to very long, slender, linear, alternate with the stamens. Fruit a trilocular capsule with numerous seeds.

Key

a. Inflorescence clearly terminal, *i. e.*, not subtended by a leafy bract appearing as a continuation of the stem.
  b. Plants dwarf, nearly or quite acaulescent, or produced stems sometimes present in no. 2; inflorescence usually much exceeded by the basal leaves.
    c. Stem very short (0.5–3 cm.), but present; ovary glabrous; capsules subglobose; outer spathe not much longer than the inner . . . . . 1. *S. hypsophilum.*
    c. Stem often absent, but produced stems sometimes present; ovary puberulous or glandular-puberulous; capsules oblong; outer spathe much longer than the inner . . 2. *S. Ivanii.*
  b. Plants taller, obviously caulescent; inflorescence not usually exceeded by the basal leaves.
    d. Cauline leaves present.
      e. Basal leaves present, forming an obvious cluster.
        f. Outer spathes longer (usually much longer) than inner spathes; pedicels equal to or shorter than the inner spathe . . . . . 3. *S. micranthum.*
        f. Spathes subequal; pedicels equal to or exceeding spathes.
          g. Roots fibrous; filaments completely united, basally glandular . . . . . 4. *S. azureum.*
          g. Roots tuberous-fasciculate; filaments less than half-united, not glandular . . . . . 5. *S. Mandonii.*
      e. Basal leaves absent, or, if a few present, not forming an obvious cluster.
        h. Cauline leaves reduced almost to spathiform bracts 6. *S. vaginatum.*
        h. Cauline leaves with obvious, although sometimes short, blades . . . . . 7. *S. Marchio.*
    d. Cauline leaves absent . . . . . 8. *S. tinctorium.*
a. Inflorescence pseudo-lateral, *i. e.*, subtended by a leafy bract appearing as a continuation of the stem.
  i. Stem broadly winged, 4–10 mm. wide; leaves to 9 mm. wide . . . . . 9. *S. macrocephalum.*
  i. Stem narrowly winged or terete.
    j. Leaves flat.
      k. Terminal bracts shorter than or nearly equal to the longest spathe; fibrous remains of old leaves at base of stems few or none; leaves not pruinose 10. *S. unispathaceum.*
      k. Terminal bract much exceeding the longest spathe; fibrous remains of old leaves at base of stem usually dense; leaves pruinose . . . . . 11. *S. rigidifolium.*
    j. Leaves filiform, appearing, or actually, terete.
      l. Plants about 5–10 cm. high . . . . . 12. *S. brevipes.*
      l. Plants about 15–50 cm. high.
        m. Outer spathe shorter than the inner; filaments not dilated.
          n. Pedicels glabrous; filaments glabrous . . . . . 13. *S. trinerve.*
          n. Pedicels pubescent; filaments yellow-villous and glandular . . . . . 14. *S. laterale.*
        m. Outer spathe longer than the inner; filaments dilated at or above the middle . . . . . 15. *S. junceum.*

1. Sisyrinchium **hypsophilum** I. M. Johnst. in herb., spec. nov.

Planta plus minusve caespitosa, rhizoma paene vel totius obsoletum. Folia omnia basalia, 2–5 cm. longa, 1–1.5 mm. lata, linearia, subacuta, 4–8-nervata, pruinosa, margines vix scabrido-ciliolati, non nisi raro ad apices. Caulis simplex, 0.5–3 cm. longus, 1 mm. latus, ancipitus, pruinosus. Spathae manifeste terminales, plerumque 14–23 mm. longae, supra bases lineari-attenuatae, exterior quam interior sublongior, interdum subbrevior, pruinosae, 2-fl., pedicelli filiformes, glabri, spathas subaequantes vel parum excedentes. Ovarium subglobosum vel ellipsoideum, glabrum, 1–1.5 mm. longum. Flores coerulei, glabri, anthesin plus minusve nutantes, tepala subaequalia, ad 9 mm. longa, 2.7 mm. lata, oblonga, 5-nervata, obtusa et breviter mucronulata. Filamenta tota coalita in tubo gracili glabro; antherae 1–1.3 mm. longae, conniventes. Stylus stamina longitudine subaequans, styli rami stamina vix excedentes. Capsula immatura subglobosa, ca. 3.5 mm. diametro; semina matura non visa.

Known only from southern Bolivia.

Tarija: Aviles: Puna Patanca, 3800 m. alt., Mar. 25, 1904, *Fiebrig*, no. 3181 (type, G; isotype, US).

This minute species suggests *S. Ivanii* and *S. brevipes* at first glance, but differs from the latter in having pruinose leaves, stems and spathes, and from the former in having a longer, wholly glabrous stamen-column and nearly globose capsules. The isotype at Washington does not clearly show the pruinosity, but the abundant material on the type-sheet shows it unmistakably.

2. S. **Ivanii,** spec. nov.

Planta caespitosa; rhizoma obsoletum. Folia omnia basalia, 2–20 cm. longa, 0.5–2.5 mm. lata, linearia, acuta, margines breviter scabrido-ciliolati supra bases vaginantes, folia aliter glabra laeviaque. Caulis saepe nullus, vel perbrevis, vel, si productus, 8–30 cm. longus, simplex, vel raro ramosus, ancipitus, margines scabriduli. Spathae terminales, inaequales, carinatae, exterior ad 5 cm. longa, margines basim circum spatham interiorem 4–5.5 mm. coaliti, foliacea, pars superior scabrido-ciliolata; spatha interior ad 2.5 cm. longa, pluriflora; pedicelli teretes glabri quam spatha interior breviores. Ovarium ellipsoideum vel turbinatum, ad 2 mm. longum, sparse puberulum vel glanduloso-puberulum. Flores coerulei vel purpureo-coerulei; tepala subaequalia, ad 7–10 mm. longa, 2–3 mm. lata, obovata, obtusa vel retusa, apiculata, extus puberula vel glanduloso-puberula. Filamenta tota coalita, columna basi glandulosa, non dilatata, ad 3 mm. longa; antherae 0.5 mm. longae, arctius approximatae. Stylus stamina longitudine subaequans; styli rami minuti, antheras haud excedentes. Capsula oblonga, ad 10 mm. longa, glabra; semina numerosa, plus minusve orbiculata vel angulata, 0.8–1 mm. diam., nigra, irregulariter foveolata, fovea micropylaris subprominens.

Bolivia and Perú.

BOLIVIA: La Paz: omasuyos: viciniis Achacache, Amapusa, Gualata, Peñas; in graminosis, etc., 3950–4100 m. alt., Jan.-Mart. 1858, *Mandon*, no. 1213 (G); Isla del Sol (Titicaca), Yumani, 3850 m. alt., Mar. 17, 1921, *Asplund*, no. 6358 (US). murillo: La Paz, 3800 m. alt., Jan. 18, 1907, *Buchtien*, no. 812 (US); near La Paz, April, 1919, *Bro. Claude-Joseph*, no. 1116 (US); La Paz, in den Bergen, 3750 m. alt., Jan. 18, 1907, *Buchtien*, no. 817 (US); same locality, Jan. 23. 1907, *Buchtien*, no. 816 in part (US, no. 1157771, mixed with *S. brevipes* and *Phaiophleps acaulis*); same locality and altitude, February, 1910, *Buchtien*, no. 816 in part (US, no. 1044959, mixed with *Oenothera nana*); La Paz, auf einer Hochebene, 4000 m. alt., Mar. 15, 1931, *Buchtien*, no. 8814 (type, US). Potosí: linares: Lagunillas, 3800 m. alt., March, 1933, *Cárdenas*, no. 442 (US). PERÚ: Junín: Rio Blanco, 15000 ft. alt., Mar. 20–25, 1923, *Macbride*, no. 2967 (US); vicinity of Oroya, 11,000–14,000 ft., 1919, *Kalenborn*, no. 103 (G).

This species has an interesting dimorphy of flowering-habit. Many plants bear flowers and capsules concealed by the bases of the leaves and lack produced stems. This is particularly true of early-season blooms, but a few plants show both the concealed capsules and produced stems. Still others, such as *Cárdenas*, no. 442, and *Macbride*, no. 2967, show no basal flowers or capsules. It is possible that the time of flowering and the amount of water available at that time may have much to do with this dimorphy. Data are scanty, but Dr. Cárdenas noted on the label of his branched no. 442 that it was found in swampy grass. All specimens, regardless of their method of flowering, have the same type of spathes, staminal column, and amount of glandularity at the base of the column.

Most of the material seen of this species had been determined as *S. chilense* Hook., but the present species differs in the disparity between outer and inner spathes, in a somewhat shorter staminal column, with rather sparse glandularity at the base only of the column, and in the usually dwarf size and unbranched habit of growth. It seems to occupy a definite geographic area in western Bolivia and the adjacent region in Perú.

I had intended to name this plant for Dr. I. M. Johnston, in recognition of his work on the genus, but the existence of *S. Johnstonii*, from Guatemala, named for Dr. J. R. Johnston, prevented that. I have, however, reached the same end with a different specific epithet.

3. S. micranthum Cav. Diss. ii. 345, t. 191, fig. 2 (1788).

Plants slender, weedy, tufted annuals. Basal leaves few to many in a tuft, to 20 cm. long and 4 mm. wide, usually shorter and narrower, linear, acute, glabrous; cauline leaves 1 to several, the upper ones reduced.

Stem simple or 1- to several-branched, geniculate when branched, narrowly ancipitous, glabrous, to 26 cm. tall. Spathes clearly terminal, unequal, the outer usually much longer than the inner, to 4.5 cm. long, but usually about 3–3.5 cm. long, the margins basally united around the inner spathe for several millimeters, the margins of the upper portion scabrid-ciliolate, several-flowered; pedicels filiform, terete, glabrous, equal to or shorter than the inner spathe. Ovary globose, 1.5 mm. in diameter, glabrous. Flowers white or yellowish, the bases of the tepals darker, usually with a broad, inverted, V-shaped, reddish or purplish band below the middle, forming a star-shaped "eye" in the center of the flower, to 9 mm. long and 2 mm. wide, externally puberulous, oblong-obovate or spatulate, apiculate. Filaments 1.5–2 mm. long, united for two-thirds to three-quarters of their length, the united portion swollen, flask-shaped, densely glandular, at least on the lower half; anthers ascending or slightly divergent, ca. 0.5 mm. long. Capsules globose, to 4 mm. in diameter; seeds dull black, globose to subpyriform, foveolate, ca. 0.6–0.8 mm. long, the micropylar pit not especially prominent.

Widespread throughout Central and South America; adventive in a number of the Pacific island groups.

La Paz: larecaja: Hacienda Simaco, sobre el camino a Tipuani, 1400 m. alt., January, 1920, *Buchtien*, no. 5362 (G, US). Yungas, 1898, *Bang*, no. 623 (G, US); nor yungas: Milluguaya, 1300 m. alt., December, 1917, *Buchtien*, no. 4297 (US); Polo-Polo, bei Coroico, 1100 m. alt., Oct.–Nov. 1912, *Buchtien*, no. 3684 (US). sur yungas: Sirupaya, bei Yanacachi, 2100 m. alt., Dec. 4, 1906, *Buchtien*, no. 392 (US). Cochabamba: Antahuacana, Espiritu Santo, 750 m. alt., June, 1919, *Buchtien*, no. 6361 (US). Santa Cruz: Cerro Tres Cruces, 1500 m. alt., Oct. 8, 1928, *Steinbach*, no. 8138 (US, G). Tarija: Bermejo, 1400 m. alt., Nov. 15, 1903, *Fiebrig*, no. 2057 (G). Without locality or date: *Bang*, no. 2578 (US).

It is possible that portions of this wide-ranging species may be varietally separated, for there seem to be some differences in capsule-size and seed-size, but until (or unless) an accurate determination is available of what Cavanilles actually had, I prefer to treat it broadly.

4. S. azureum Phil. Fl. Atac. 50 (1860); Johnston in Journ. Arnold Arb. xix. 396 (1938).

Plants perennial, somewhat caespitose, the rhizome obsolete, roots coarse but not tuberous-fasciculate. Basal leaves to 22 cm. long, but usually shorter, 2–2.5 mm. wide, linear, acute, the margins scabrid-serrate, otherwise glabrous; cauline leaves similar to the basal leaves. Stems erect or somewhat geniculate, simple or branched from the middle or above the middle, to 45 cm. long, ancipitous, the edges scabrid-serrate. Spathes obviously terminal, equal or subequal, to 1.7 cm. long, the outer lanceolate, acute, with the basal margins united around the inner spathe for 4–5 mm., the line of union coarsely ciliolate, the inner spathe more

nearly ovate, obtuse, margins and apex scarious, both spathes otherwise herbaceous, markedly ribbed, carinate, the keels scabrid-ciliolate, several-flowered, the slender, sparsely pubescent, subancipitous pedicels from shorter to longer than the spathes at anthesis. Ovary subglobose to turbinate, pubescent or glandular-pubescent, 1.5–2 mm. long. Flowers blue, puberulent on both faces, the tepals subequal, to 1.1 cm. long and 3–4 mm. wide, obovate, obtuse or retuse, from mucronulate to long-apiculate. Filaments completely united, glandular on the lower third, occasionally glandular nearly to the middle, 4–5 mm. long; anthers oblong-ovoid, 0.8–1 mm. long. Style as long as the column, the style-arms barely, if at all, visible. Capsule glabrous or glabrate, oblong to subglobose, to 7 mm. long; seeds flattened-globose, 1 mm. in diameter, black, reticulate-foveolate, the micropylar pit prominent.

Bolivia, northwestern Argentina, Perú and Chile.

La Paz: larecaja: Sorata, 8000 ft. alt., February, 1886, *Rusby*, no. 694 (G, US); vic. Sorata, 2600–2800 m. alt., Jan.–Mar. 1858, *Mandon*, no. 1211 (G). murillo: base of Mt. Illimani, valley of Rio Palca, 2360 m. alt., *Bro. Julio*, no. 6, (US); Obrajes, 3400 m. alt., May, 1919, *Buchtien*, no. 4546 (US). Cochabamba: vic. Cochabamba, 1891, *Bang*, no. 999 (G, US); Cochabamba, 2550 m. alt., Feb. 1942, *Cárdenas*, no. 2282 (G); Cochabamba, 1930, *Bro. Julio*, no. II, 39 (US). mizque: Mizque, 2000 m. alt., January, 1947, *Cárdenas*, no. 3862 (G). Tarija: Tolomosa, ca. 1900 m. alt., Jan. 17, 1902, *R. E. Fries*, no. 1068a (US); Tucumilla bei Tarija, Jan. 16, 1904, *Fiebrig*, no. 3298 (G, US); Tambo, 62 km. north-east of Tarija on road to Villa Montes, 2000 m. alt., Feb. 6, 1937, *J. West*, no. 8280 (G).

Although there are some discrepancies between the original description and that given here, I am following Johnston (l. c.) in the application of the name to a well-marked group of plants.

5. S. Mandonii Baker in Journ. Bot. xiv. 269 (1876); Baker, Handbk. Irid. 128 (1892); Woodson & Schery in Ann. Missouri Bot. Gard. xxxii. 39 (1945).

Plants perennial, the rhizomes obsolete, roots fibrous and slender or tuberous-fasciculate, the short tubers densely short-villous. Basal leaves few to many, surrounded at the base by a short dense collar of fibrous remnants of old leaf-bases, to 30 cm. long, 3 mm. wide, linear, glabrous but with the margins short-scabridulous; cauline leaves 1 to several, to 20 cm. long, 3 mm. wide, none terminal on the stem. Stem 1–several-branched, rarely simple, obscurely ancipitous, the ridges scabridulous, at least below the nodes, somewhat papillose above, otherwise glabrous, to about 35–40 cm. long, the spathes clearly terminal. Spathes 3–4-flowered, subequal, to 2.4 cm. long, herbaceous, carinate, the keels scabridulous, the outer spathe lanceolate, acuminate, acute, the margins united at the base around the inner spathe for 4–5 mm., the inner spathe ovate, obtuse, with a brown scarious margin, the angular, filiform, sparsely puberulent or glabrous pedicels somewhat exceeding the spathes at anthesis. Ovary

oblong or ellipsoid, to 4–5 mm. long, glabrous. Flowers yellow, veined with dark brown, glabrous, the tepals subequal, to 1.5 cm. long, 4–5 mm. wide, obovate, mucronulate. Filaments to 4 mm. long, united at the base for about 1.5 mm., glabrous, the united portion not dilated; anthers linear, to 3 mm. long, versatile, divergent. Style slightly longer than the stamen-column; style-arms ca. 3 mm. long, spreading. Capsule oblong, to 1.3 cm. long, glabrous; seeds subglobose, ca. 1.5 mm. in diameter, black, slightly foveolate, with a broad, deep, micropylar pit.

Bolivia and Panamá; reported by Baker for Colombia, but no material from that country has been seen by me.

La Paz: larecaja: Lancha (?) de Cochipata, in scopulosis montis Illampú, 3300 m. alt., Jan.–May, 1860, *Mandon*, no. 1217 (type, not seen; isotype, G, in large part); Ingenio del Oro, 10000 ft. alt., March, 1886, *Rusby*, no. 697 (US); Mapiri, 8000 ft. alt., April, 1886, *Rusby*, no. 698 (US).

The single Bolivian sheet of this species in the Gray Herbarium has six specimens on it. Four of these are obviously conspecific and agree with Baker's original description. The other two are probably present as a result of a mixture with *Mandon*, no. 1216; at least, they are conspecific with it. Unfortunately, all four of the specimens of *S. Mandonii* are in fruit, as are the other sheets seen. Consequently, it has been necessary to draw floral details from Baker's description and from a Panamá specimen, *Woodson & Schery*, no. 427 (G). I have tried to find some means of distinguishing the Panamá material from the Bolivian and have been completely unable to do so.

6. S. vaginatum Spreng. Syst. i. 166 (1825); Baker, Handbk. Irid. 129 (1892); see also Beauverd in Bull. Herb. Boiss. (II) v. 1082 (1905), in the discussion of *S. vaginatum* subsp. *restioides* (Spreng.) Beauv.

Plants perennial, caespitose, the rhizome short or obsolete. Basal leaves none or few, greatly reduced in size if present. Stems to 40 cm. long, about 1 mm. wide, ancipitous, the edges scabridulous, occasionally simple but usually branched, loosely or closely set with reduced, spathiform, lance-linear leaves, these half-sheathing, 1–1.5 cm. long, densely ciliate above the sheath, the short, acerose-tipped, free portion incurved toward the stem. Spathes terminal, to 1.4 cm. long, unequal, the outer shorter than the inner and ciliate on the lower margins, lance-linear, rigid, acerose-tipped, 1-flowered, the filiform glabrous pedicel slightly shorter than the inner spathe. Ovary subglobose, 1.5–2 mm. long, glabrous. Flowers yellow, glabrous, the tepals subequal, ca. 5 mm. long, 2 mm. wide, ovate-obovate. Filaments glabrous, basally united for 1–1.5 mm., free for about 1.5 mm.; anthers linear, ca. 2 mm. long. Style as long as the undilated base of the filaments; style-arms 1.5–2 mm. long, spreading.

Bolivia, Uruguay, Argentina and Brazil.

Santa Cruz: near Comarapa, 2500–3300 m. alt., Oct. 26, 1928, *Steinbach*, no. 8333 (G).

The name *S. vaginatum*, used here in its broadest sense, is applied to a complex of variations occurring throughout a large area. Until European types can be studied, it is impossible to fix the real application of *S. vaginatum* and other binomials applied to members of this complex.

7. S. Marchio (Vell.) Steud. Nomencl. (ed. 2) ii. 596 (1841).
Souza Marchio Vell. Fl. Flum. 273 (1825), and Icones, vii. t. 1 (1827).

Plants perennial, caespitose, the rhizomes short or obsolete. Basal leaves none, rarely 1–2, reduced, not forming an obvious basal cluster; cauline leaves numerous, basally sheathing, to 20 cm. long and 1 cm. wide, often rather closely imbricate, broadly linear-falcate, glabrous, acute, the blade often incurved toward the stem. Stem simple or branched, the branching usually above the middle, geniculate, rather broadly ancipitous, to 55 cm. tall, usually much shorter. Spathes clearly terminal, the outer longer than the inner, to 4 cm. long, foliaceous, acute, the inner herbaceous, acute, several-flowered, the glabrous filiform pedicels shorter or longer than the inner spathe at anthesis. Ovary subglobose, glabrous, 2 mm. in diameter. Flowers yellow, glabrous, the tepals subequal, to 1.3 cm. long, 4 mm. wide, obovate, acute. Filaments to 5 mm. long, united basally for less than half their length, the free portions ascending-divergent, the united portion glabrous, not dilated; anthers linear, to 4 mm. long, divergent. Style as long as the stamen-tube; style-arms linear, divergent, to 3 mm. long. Capsule more or less globose, sometimes ovoid, to 1 cm. long; seeds flattened-globose, 1.5 mm. in diameter, black, shallowly reticulate-foveolate, the micropylar pit absent.

Widespread throughout South America, except possibly on the west coast.

La Paz: larecaja: Hacienda Simaco sobre el camino a Tipuani, 1400 m. alt., March, 1920, *Buchtien*, no. 5361 (G); vic. Sorata, Mt. Chilieca, 3200 m. alt., 1857–58, *Mandon*, no. 1216 (G). Yungas, 1890, *Bang*, no. 623a (G, US); nor yungas: Unduavi, 3200 m. alt., November, 1910, *Buchtien*, no. 2606 (G, US); Unduavi, 3400 m. alt., October, 1931, *Buchtien*, no. 8297 (US); sur yungas: Sirupaya bei Yanacachi, 2300 m. alt., Dec. 15, 1906, *Buchtien*, no. 393 (US). Cochabamba: chapare: Incachaca, 2500 m. alt., Oct. 21, 1920, *Steinbach*, no. 5030 (G); Incachaca, 2300 m. alt., Feb. 28, 1929, *Steinbach*, no. 9316 (G). Tarija: Toldos bei Bermejo, 2200 m. alt., Dec. 11, 1903, *Fiebrig*, no. 2391 (G). Without locality, number or date, *Bang* (G).

The remarks made concerning the previous species, *S. vaginatum*, apply with equal force to *S. Marchio*. Material collected by Haught in Colombia and by Fiebrig in Paraguay is an almost perfect match for *S. alatum* var. *minor* Rusby, of which I have seen an isotype, *R. S. Williams*, no. 114 (US). When the species-complex can be studied as a whole, this element is almost certain to be segregated, and for that reason I have not formally placed the name in synonymy.

8. S. TINCTORIUM HBK. Nov. Gen. & Spec. i. 324 (1816); Baker, Handbk. Irid. 127 (1892); Woodson & Schery in Ann. Missouri Bot. Gard. xxxii. 40 (1945).

Plants perennial, caespitose, often developing slender rhizomes, the roots rather coarse. Leaves all basal, 4–16 cm. long, 1–4 mm. wide, linear, glabrous, acute, erect or spreading. Stem simple, glabrous, strongly ancipitous, to 60 cm. tall, but usually much shorter, and 3 mm. wide. Spathes terminal, several-flowered, equal or subequal, or the outer as much as 1 cm. longer than the inner, to 3 cm. long, herbaceous, the outer spathe lanceolate, acuminate, subacute, the inner spathe broader, obtuse, the margin hyaline, the filiform, terete, glabrous pedicels exceeding the spathes at anthesis. Ovary subturbinate to subglobose, glabrous, to 2–3 mm. long. Flowers yellow, veined with dark brown, glabrous, the tepals subequal, to 1.3 cm. long and 4 mm. wide, elliptic-ovate, subacute. Filaments to 4–5 mm. long, glabrous, basally united for ca. 2 mm., the united portion not swollen; anthers linear, 4 mm. long, more or less divergent. Style about as long as the stamen-column, or slightly longer; style-arms to 3–4 mm. long, spreading. Capsules nodding on recurved pedicels, broadly ovoid, glabrous, to 1 cm. long; seeds globose, black, irregularly foveolate, 2 mm. in diameter, the micropylar pit broad and deep.

Mexico and Central America southward, especially in the Andean area.

LA PAZ: LARECAJA: viciniis Sorata; Cochipata, in paludosis, 3100 m. alt., Nov. 1857, *Mandon*, no. 1215 (G, US). MURILLO: La Paz, in Sümpfen, 3800 m. alt., Jan. 12, 1907, *Buchtien*, no. 813 (US); La Paz, in einem Sumpfe, 3800 m. alt., Feb. 12, 1907, *Buchtien*, no. 8818 (US). COCHABAMBA: CERCADO: Cochabamba, 2600 m. alt., 1930, *Bro. Julio*, no. II, 131 (US).

Mandon, no. 1215, and *Buchtien*, no. 813, have the spathes almost equal, differing from typical *S. tinctorium*, in which the outer spathe is much longer than the inner. It is possible that some of the Bolivian material is varietally distinct, but on several stems of *Buchtien*, no. 8818, the outer spathe is longer than the inner, in one instance as much as 1 cm. longer.

9. S. MACROCEPHALUM R. Graham in Edinb. New Philos. Journ. 176 (January, 1833); Baker, Handbk. Irid. 132 (1892), as syn. of *S. palmifolium* L.; Macbride in Field Mus. Pub. Bot. xiii. 713 (1936), as *S. palmifolium;* Johnston in Journ. Arnold Arb. xix. 383 (1938).

Plants perennial, caespitose, the rhizome usually short or even obsolete, the roots coarse, thick, but apparently not tuberous-fasciculate. Basal leaves few to many in a tuft, to 50 cm. long and 9 mm. wide, linear-ensiform, acute, glabrous, the edges thin and sharp, numerous ribs prominent. Stem simple, to 80 cm. long and 1 cm. wide, glabrous, broadly ancipitous, terminated by a cauline leaf 3–6 cm. long, appearing to be a continuation of the stem and subtending the pseudo-lateral, fascicled, or more or less cymose, clusters of spathes. Spathes subequal,

to 3 cm. long, herbaceous, rigid, carinate, strongly ribbed, the outer lanceolate, acerose-tipped, the inner ovate, obtuse, the apex and margins tending to be white- or brown-scarious, several-flowered, the glabrous, rather flattened or angular pedicels equaling or exceeding the spathes at anthesis. Ovary turbinate, 3–4 mm. long, glabrous. Flowers yellow, veined dark brown, glabrous, tepals subequal, to 1.5 cm. long and 6–7 mm. wide, ovate to obovate, acute. Filaments glabrous, to 5 mm. long, united at the base for 1 mm.; anthers 4 mm. long, linear, divergent, coiling downward with age. Style about 3 mm. long; style-arms ca. 3 mm. long, spreading. Capsule globose or subglobose, obtusely trigonous, glabrous, to 1 cm. long; seeds globose or flattened-globose, 2 mm. in diameter, black, reticulate-foveolate, the micropylar pit absent.

Bolivia, Perú, Argentina, Uruguay, Paraguay and Brazil.

TARIJA: Cuesta de Sama, 32 km. northwest of Tarija, on road to Villazon, rocky hillside, 2800 m. alt., Feb. 12, 1937, *J. West*, no. 8331 (G); Tucumilla, Pinos, 1900–2700 m. alt., December, 1903, *Fiebrig*, no. 2407 (G). SANTA CRUZ: near Comarapa, 2800 m. alt., Oct. 20, 1928, *Steinbach*, no. 8334 (G). COCHABAMBA: Ayopaya, wet grassy soil, 3500 m. alt., November, 1933, *Cárdenas*, no. 3307 (G).

I have followed Johnston (l. c.) in using the name *S. macrocephalum* for this species instead of the Linnaean *S. palmifolium*, in view of the doubt which still exists as to the exact identity of the Linnaean plant. It has not seemed necessary to repeat the synonymy given by Johnston.

10. S. UNISPATHACEUM Klatt in Linnaea, xxxiv. 737 (1865–66); Baker, Handbk. Irid. 126 (1892).

Plants perennial, densely caespitose, the rhizome obsolete, the roots coarsely fibrous. Basal leaves numerous in a tuft, to 50–60 cm. long, 1–2 mm. wide, linear, acute, glabrous. Stem simple, glabrous, obscurely ancipitous, somewhat sulcate, the edges scabridulous at the apex, to 50 cm. long, terminated by a short, 1.2–2.2 cm. long, spathiform, lanceolate, acuminate, cauline leaf, appearing a continuation of the stem. Spathes herbaceous, several-flowered, markedly unequal, the outer lanceolate, acuminate, acute, 1.2–1.7 cm. long, the inner ovate, obtuse, 2–3.2 cm. long, the filiform, angular, glabrous pedicels shorter than the spathes at anthesis. Ovary glabrous, ellipsoid, ca. 4 mm. long. Flowers yellow, veined with brown, glabrous, the tepals subequal, to ca. 1.3 cm. long and 3–4 mm. wide (?). Filaments glabrous, to 4.5–5 mm. long, united at the base for 1.5–2 mm., the united portion not dilated; anthers 3 mm. long, divergent. Style as long as the stamen-column; style-arms to 4 mm. long, spreading. Capsule glabrous, oblong, to 2 cm. long; mature seeds not seen.

Known only from Bolivia.

LA PAZ: LARECAJA: viciniis Sorata et Yani, prope Cochipata, Pocara, etc., in dumosis, 3200–3500 m. alt., Feb.–May, 1859, *Mandon*, no. 1219 (TYPE, not seen; isotypes, G, US). Without locality or date, *Bang*, no. 1922 (G, US).

On the five sheets available of this species, no mature flowers in good preservation have been found. From a bud-dissection and from the few remnants of flowers, the details given above have been pieced together. Although the size and shape of the flower may still be a little doubtful, there is no uncertainty as to the structure of the stamens and style. This species has, at times, been confused with *S. Mandonii*, but it can easily be separated by the lack of cauline leaves (except the terminal bract) and by the unequal spathes.

11. S. RIGIDIFOLIUM Baker, Handbk. Irid. 131 (1892); Macbride in Field Mus. Pub. Bot. xiii. 714 (1936).

Plants perennial, densely caespitose, the rhizome very short or obsolete, roots coarse, densely white-pubescent, at least when young. Leaves few to many in a tuft, basal, surrounded by a variably dense fibrous collar of old leaf-bases, to 18 cm. long and 2 mm. wide, linear, acute, stiffly erect, finely ribbed, with two ribs prominent, densely pruinose. Stem simple, to 30 cm. tall, usually much shorter, from scarcely to markedly ancipitous, 2 mm. wide, pruinose, terminated by a spathiform cauline leaf to 6 cm. long, subtending 1 to several pseudo-lateral spathe-clusters, the outer margin of the leaf, papillose-scabrid. Spathes not pruinose, somewhat unequal, several-flowered, the outer spathe herbaceous with the margins brown-hyaline, long-acute, to 2 cm. long, the inner slightly shorter and partially brown-scarious, obtuse, the flattened glabrous pedicels shorter than the spathes. Ovary ovoid to ellipsoid, to 4 mm. long, glabrous. Flowers blue, pink, or purplish (?), glabrous, the oblong-obovate tepals subequal, to 1.6 cm. long and 6 mm. wide, obtuse, few-veined. Filaments glabrous, to 6 mm. long, free for over half their length, the free portions flat, broad, tapering upward, the united portion not swollen; anthers linear, divergent, to about 4 mm. long. Style as long as the stamen-column; style-arms to 5 mm. long, spreading. Capsule oblong, somewhat trigonal, torulose, to 6–7 mm. long; seeds flattened-globose, ca. 1.5 mm. in diameter, dull black, somewhat foveolate, with a broad deep micropylar pit.

Bolivia and Perú.

LA PAZ: OMASUYOS: viciniis Achacache; monticula Avichaca, in glareosis, 4000 m. alt., Jan.–Apr. 1861, *Mandon*, no. 1214 (TYPE, not seen; isotypes, G, US); Isla del Sol, Yumani, 3850 m. alt., Apr. 12, 1921, *Asplund*, no. 6359 (US). MURILLO: La Paz, auf den Bergen, 3900 m. alt., Mar. 2, 1907, *Buchtien*, no. 811 (US); La Paz, an einem Bergabhange, 4000 m. alt., Mar. 15, 1931, *Buchtien*, no. 8815 (G, US); Unduavi Valley, *Bro. Julio*, no. 364 (US). INGAVI: Guaqui, 3900 m. alt., Feb. 1921, *Asplund*, no. 6360 (US). COCHABAMBA: Cochabamba, 2600 m. alt., 1930, *Bro. Julio*, no. II, 173 (US).

Although this species is frequently misdetermined, it is actually one of the easiest of the Bolivian species to recognize. Of all the Bolivian members of the group with a cauline leaf

terminating the stem and a pseudo-lateral inflorescence, *S. rigidifolium* is the only species with pruinose leaves and stems.

12. S. BREVIPES Baker, Handbk. Irid. 130 (1892); Macbride in Field Mus. Pub. Bot. xiii. 711 (1936).

Plants perennial, caespitose, the rhizome obsolete. Basal leaves few to many in a tuft, surrounded by the fibrous remains of old leaf-bases, the bases sheathing, blades subterete or fistulose, to 7 cm. long, 1 mm. wide, glabrous, finely ribbed, acute. Stems simple, arcuate, glabrous, more or less flattened, 4–10 cm. high, terminated by a cauline leaf appearing as a continuation of the stem, to 1.8 cm. long, the base sheathing, the blade similar to those of the basal leaves, immediately subtending one pseudo-lateral spathe-cluster. Spathes to 1.2 cm. long, obtuse, the outer slightly shorter than the inner, herbaceous, with broad white hyaline margins, several-flowered, the glabrous subterete pedicels much shorter than the spathes. Ovary glabrous, ellipsoid, 3 mm. long, not, or only in part, exserted from the spathes. Flowers yellow, the tepals subequal, to 4 mm. long and 2 mm. wide, obovate, obtuse, 5-veined, glabrous. Filaments to 2–2.5 mm. long, united for about 1 mm., the united portion glabrous, not swollen; anthers ca. 1 mm. long, rather divergent. Capsule oblong, to 8 mm. long, glabrous; seeds flattened-globose, 1 mm. in diameter, foveolate, black, the micropylar pit fairly deep but not broad.

Bolivia and Perú.

LA PAZ: LARECAJA: viciniis Sorata; Apachata de Gualata, etc., in apricis, 3800–4000 m. alt., Jan.–Apr. 1860, *Mandon*, no. 1221 (G). MURILLO: La Paz, 4100 m. alt., May, 1910, *Buchtien*, no. 814 (US); La Paz, altiplanicie, 4100 m. alt., Mar. 28, 1907 and May, 1910, *Buchtien*, no. 814 (US); La Paz, 3750 m. alt., Jan. 23, 1907, *Buchtien*, no. 816 in part (US).

From the other dwarf species, *S. Ivanii* and *S. hypsophilum*, *S. brevipes* may be distinguished by its yellow flowers, veined with brown, by the half-free filaments, with the linear anthers divergent, and by the style-arms, which are as long as the style. In vegetative characters, it is marked by the pseudo-lateral inflorescence and by the more or less dense fibrous collar formed by the old leaf-bases.

13. S. TRINERVE Baker in Journ. Bot. xiv. 267 (1876); Baker, Handbk. Irid. 122 (1892); Macbride in Field Mus. Pub. Bot. xiii. 714 (1936).

S. Bakeri Klatt, Ergänz. 44 (1882), *nomen illegitimum*.

S. cryptocarpum Rusby in Mem. Torr. Bot. Club, vi. 126 (1896).

Plants densely caespitose, perennial, the rhizome short, slender. Leaves apparently all basal except one, nearly or actually terete, to 50 cm. long, 0.5 mm. wide, acute, glabrous, several-nerved but usually only 3 nerves visible, the bases surrounded by the fibrous remains of old leaves. Stem to 47 cm. tall, simple, terete or somewhat sulcate, glabrous, terminated by a reduced spathiform cauline leaf immediately subtending the spathes, 2–7.5 cm. long. Spathes somewhat unequal, 2–3 cm. long, the outer

shorter than the inner, with a narrow hyaline edge, or this sometimes absent, apically membranous, obtuse or subobtuse, 2–4-flowered, the filiform glabrous pedicels slightly shorter than the spathes. Ovary ellipsoid, glabrous, 3–4 mm. long. Flowers yellow, the tepals subequal, oblong-elliptic, about 5-veined, at least 1 cm. long, 3 mm. wide, glabrous. Filaments ca. 3.5 mm. long, glabrous, united for 1–1.5 mm. at the broadly conic base, free for 2–2.5 mm.; anthers linear, 3 mm. long, divergent. Style as long as the stamen-column; style-arms stout, 2 mm. long. Capsule ellipsoid to oblong, subtorulose, to 9 mm. long; seeds shiny black, flattened-globose, somewhat foveolate, 1.5 mm. wide, the micropylar pit broad and moderately deep.

Known certainly from Bolivia and Perú and probably from northern Argentina and Colombia.

COCHABAMBA: near Cochabamba, 1891, *Bang*, no. 1073 (G, US, isotypes of *S. cryptocarpum*); Toralapa, wet grassy situations, 3600 m. alt., January, 1946, *Cárdenas*, no. 3656 (G). LA PAZ: LARECAJA: near Sorata, 3000–5000 m. alt., *Mandon*, no. 1218 (TYPE, not seen; isotype, G). MURILLO: La Paz, in den Bergen, 3800 m. alt., Mar. 15, 1907, *Buchtien*, no. 815 (US); La Paz, Cerro del Calvario, 3900 m. alt., Feb. 12, 1931, *Buchtien*, no. 8816 (US). NOR YUNGAS: Unduavi, am Waldrande, 3300 m. alt., Feb. 12, 1907 (US), and November, 1910 (G), *Buchtien*, no. 818. Without locality or date: *Bang*, no. 2579 (US).

Even in flower, this species has great similarity to *S. laterale*, but it can be distinguished by the fact that the filaments in *S. trinerve* are only partially united, glabrous, and bear long, linear, divergent anthers. *S. laterale* has the filaments almost completely united, glandular and villous, bearing short, closely approximate anthers. Non-flowering material is separated less easily, but in the limited number of specimens available, *S. trinerve* consistently has spathes with a narrow hyaline margin, and glabrous pedicels. *S. laterale*, in the scanty material seen, has spathes with the white hyaline margins broader and more easily ruptured, and the pedicels puberulent. From *S. junceum*, *S. trinerve* can be distinguished by its yellow flower-color, glabrous ovary, partially free filaments, with the united portion not enlarged above the base, and the solitary spathe-groups sessile in the subtending bracts. In contrast, *S. junceum* has pink flowers, a glandular-pubescent ovary, completely united filaments, with the column dilated above the middle, and solitary spathe-clusters short-peduncled in the basal sheaths of the subtending bracts.

The original description of *S. cryptocarpum* stated that flowers were unknown and the plant was referred to *Sisyrinchium* with some hesitation. On the isotype of *S. cryptocarpum* in the Gray

Herbarium, there was an old withered flower which was dissected with only passable results. On another isotype at Washington, there was a very young plant with all flowers in bud. A bud-dissection gave similar but clearer results and left no doubt that *S. cryptocarpum* must become a synonym of *S. trinerve*.

14. S. LATERALE Baker in Journ. Bot. xiv. 269 (1876); Baker, Handbk. Irid. 122 (1892); Macbride in Field Mus. Pub. Bot. xiii. 714 (1936).

Plants perennial, caespitose, the rhizome obsolete, the thick younger roots densely white-villous. Leaves numerous, all basal except one, the outer leaves 5–10 cm. long, the inner leaves to 30 cm. long, 1 mm. wide, subulate-terete, sulcate, glabrous, finely ribbed, acute. Stem simple, terete, sulcate, glabrous, about 30 cm. long, terminated by a terete cauline leaf, sheathing at the base, 5–14 cm. long, subtending 2 spathe-clusters, the lower margins of the leaf ciliolate. Spathes unequal, the outer shorter than the inner, 1.5–2.2 cm. long, finely ribbed, the hyaline margins white, the apices acute or acerose, each cluster 2-flowered, the filiform terete pedicels sparsely pubescent and exceeding the spathes by 5–8 mm. at anthesis. Ovary ellipsoid to subturbinate, to 3 mm. long, glandular-pubescent. Flowers yellow, pubescent on the exterior, especially at the base, the tepals subequal, oblong-ovate, mucronulate, about 8–9 mm. long, ca. 2 mm. wide, 3 (–5 ?)-veined. Filaments 3–3.5 mm. long, united for 2.5–3 mm., free for ca. 0.5 mm., densely yellow-villous and apparently sparsely glandular at the base, becoming more sparsely villous upward; anthers more or less connivent, oblong-ovoid, 1 mm. long. Style at least as long as the column; style-arms not exceeding the anthers. Immature capsule globose, 4 mm. in diameter, pubescent; seeds not seen.

Known only from Bolivia.

LA PAZ: LARECAJA: viciniis Sorata, Cerro del Iminapi, in graminosis, 2650–2800 m. alt., Feb.–Apr. 1858, *Mandon*, no. 1220 (TYPE, not seen; isotypes, G, US).

The differences between *S. laterale* and *S. trinerve* have been sufficiently discussed under that species.

It seems possible, from the description, that *S. pictum* Kränzl. in Fedde, Repert. Spec. Nov. xiii. 119 (1914), is a synonym of *S. laterale*, but no material has been available to me. If this is correct, the range is extended to SANTA CRUZ: VALLE GRANDE: Mt. Pampalarga, above Valle Grande, ca. 2550 m. alt., March, 1911, *Herzog*, II, 1844 (TYPE of *S. pictum*, not seen).

15. S. JUNCEUM E. Mey. in Presl, Rel. Haenk. i. 118 (1827); Baker, Handbk. Irid. 123 (1892); Macbride in Field Mus. Pub. Bot. xiii. 712 (1936).

Plants perennial, loosely caespitose, the coarse roots pubescent, at least when young. Leaves few to several in a tuft, flaccid, to 30 cm. long and 1–1.5 mm. wide, terete or subterete, glabrous, finely ribbed, acute, long-

sheathing at the base. Stems simple, often several in a tuft, 10–50 cm. tall, terete, glabrous, terminated by a cauline leaf appearing as a continuation of the stem, 4–15 cm. long, sheathing at the base. Spathe-clusters solitary, short-peduncled, the peduncle mostly concealed by the base of the cauline leaf, pseudo-lateral, spathes unequal, the outer longer, to 4 cm. long, acute, herbaceous but with a broad hyaline margin, the inner spathe a few millimeters shorter, obtuse, partly herbaceous, the hyaline margin broader, several-flowered, the slender, more or less terete, glabrous pedicels from shorter than to greatly exceeding the spathes at anthesis. Ovary subglobose to ovoid, glandular-pubescent, 2–4 mm. long. Flowers rose-pink, rather nutant, glabrous; outer tepals to 1.3 cm. long and ca. 3–4 mm. wide, elliptic, acute, mucronulate, few-veined; inner tepals similar but 2–3 mm. shorter. Filaments united, to 5 mm. long, glabrous, swollen above the middle and narrowed again at the apex; anthers linear, 3 mm. long, rather approximate. Style to 8 mm. long, conspicuously exceeding the anthers; style-arms ca. 0.4 mm. long. Capsule oblong, obscurely trigonous, glabrous or glabrate, to 1.3 cm. long; immature seeds dark brown, angled from pressure.

Bolivia, Perú, Argentina and Chile.

La Paz: larecaja: vic. Sorata, Anilaya, Lacatia, etc., in scopulosis graminosis, 3200–4500 m. alt., Jan.–Apr. 1860, *Mandon*, no. 1222 (G, US). pacajes: General Campero, 4200 m. alt., Mar. 4, 1921, *Asplund*, no. 6357 (US). ingavi: Guaqui, 3900 m. alt., Feb. 21, 1921, *Asplund*, no. 6536 (US). Cochabamba: vic. Cochabamba, 1891, *Bang*, no. 1075 (G, US). Potosí: linares: Lagunillas, 3800 m. alt., March, 1933, *Cárdenas*, no. 418 (US). Without locality or date: *Bang*, no. 1864 (G, US).

Study of the material indicates that probably two or more species are being included under this name. The Bolivian specimens agree with the larger proportion of Chilean material treated as *S. junceum*, and until the exact application of the name can be fixed, I shall apply the name as used here.

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CLXVII

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(Plates 1097–1117)

Part I. Prefatory Notes by Dr. Schubert

In the early spring of 1945, when the work on the new edition of Gray's Manual had progressed to the point where only problems remained, Professor Fernald spoke occasionally of the necessity of having photographs of many of the type-specimens in British herbaria. In May of that year, shortly after V-E Day, he suggested that perhaps I could go to Britain when the war ended; and in August, during the two-day holiday proclaimed after V-J Day, he began to form a definite plan. In the winter of 1945–46, after being assured in correspondence with botanical colleagues at the British Museum (Natural History) and at Kew that their specimens might be returned from wartime sanctuaries and in working order by May, although other conditions might not be favorable, the likelihood of the project seemed less remote. The passage of three years since the beginning of preparations have now made the difficulties of the period from March, 1946, to the end of October, when I finally embarked on the Queen Elizabeth, seem much less enormous. A pleasant haze has settled over what seemed at the time very grim circumstances, surely not to be forgotten so soon. The really.

outstanding recollection now is of the help very generously given us by friends[1] of the Gray Herbarium and by the members of the staff.

The strictly technical problems of camera and equipment had of necessity to be worked out in great detail because the possibility of buying anything at all abroad was not to be considered. With the aid and ingenuity of Dr. Ian D. Clement, then a graduate student very recently returned from service in Britain, this particular set of problems was worked out with sufficient care so that, with only minor modifications after arrival at the British Museum, the work was carried out as planned with no loss of negatives. The equipment, though simple, was designed with several considerations in mind, among them need for the least possible weight and probable lack of special lighting equipment and dark-room. We decided that the most portable case for carrying all the equipment would be a standard size student's laundry-case, which, after the camera, a Voigtlander Avus, $2\frac{1}{4} \times 3\frac{1}{4}$, was our first acquisition. With the inside measurements of the case at hand Dr. Clement proceeded to design a copying stand which could be used at one limit to photograph whole specimens (at $\frac{1}{5}$ natural size) and at the other to photograph details at natural size. Built in the University workshop, the extendable vertical rack was attached to the base by bolts and wing-nuts and the two portions of the rack were similarly joined, but the whole stand could be separated and packed with enough room left for film, film-holders, change-bag, notes, etc. The completely full case, with sufficient equipment for taking approximately one thousand specialized photographs (including all needs except lights), weighed 38 pounds, a not impossible load and one with sufficient padding in the form of "lab-coat" and kleenex to withstand the rigors of travel.

While the camera-stand was being constructed my occupations were many: trying to procure passage, finding film in quantity, copying descriptions of all the species to be studied and, in general, getting ready for a trip which might begin in May of 1946 or a year from then.

A passport was not received until late in June and then the

[1] Particularly the financial aid from Miss Edith Scamman, Mr. Walter D. Edmonds and Mr. Philip Wrenn.

vicious circle of "no visa, no passage; no passage, no visa" was run around for about two months until the British Consul, by this time probably a little tired of my frequent calls, said if all haste were made I could probably get passage on the Queen Elizabeth and if I did he would assume the responsibility of giving me a visa. Finally on the 28th of October, with too much luggage and a full sheaf of documents, I embarked on the beautifully refinished Cunarder in a state of complete exhaustion and great uncertainty. I do not know what I expected that distracted me to the point of leaving one piece of baggage in Customs at Southampton and the case with *all* my notes on the train at Waterloo Station (both of which, thanks to British efficiency, were very soon recovered) but my equilibrium returned promptly on reaching the British Museum in South Kensington.

The complete friendliness with which I was received by the Keeper of the Botany Department and his staff was very reassuring and the amount of help given me, particularly by Dr. George Taylor, immeasurable. For some weeks before my arrival Dr. Taylor, the Deputy Keeper, and his assistant, Mr. L. H. J. Williams, had worked from lists sent earlier, to get out a large number of the specimens I needed (since the Herbarium was not yet rearranged in actual working order). This meant a great saving in time and made it possible to start photographing immediately.

As Dr. Clement and I had expected, an unforeseen problem arose at once—the herbarium-sheets at the British Museum are considerably larger than the standard size in American herbaria. This required certain rearrangements but there was enough leeway in the rack so that the difficulty was satisfactorily overcome. The matter of lighting which had somewhat concerned us offered no particular problem and three (or sometimes only two) ordinary desk-lamps provided sufficient light.

During my six continuous weeks at the British Museum I took some 400 photographs of about 300 specimens in addition to the Walter Herbarium, photographed in its entirety and described in detail later in this paper. In the problems of photography particularly, Mr. James A. Crabbe of the technical staff was especially helpful and encouraging.

In many historical and bibliographical as well as taxonomic

questions Mr. A. H. G. Alston took particular pains to assist me. He also arranged a visit to the Chelsea Physic Garden, once in the charge of Philip Miller, many of whose types I was studying.

Both space and time prohibit my writing in any more detail of my stay at the British Museum. Although the larger amount of material needed was there, important types were also at Kew and in the middle of December I started working there, although, because of the acute housing shortage, I continued to live in South Kensington (on the tiny but well protected street on which Mr. Winston Churchill resides).

At Kew (where in contrast to the British Museum there was essentially no war-damage) I felt very much at home and it was obvious that the basic plans for the Gray Herbarium building were adapted from this splendid herbarium. The Keeper, Dr. Turrill, Mr. Sandwith in charge of American plants, Mr. Summerhayes in charge of *Orchidaceae*, and many others helped me to make rapid progress and do as much as possible in my limited time. The technical problems, solved in South Kensington, were no longer of any consequence. At Kew, in addition to studies of the North American types, it was also possible to photograph, though not study, types in many Central and South American genera in which my colleagues and I had special interest. In all I made just over 100 photographs at Kew and settled several bibliographical questions. Before Christmas too, I made a hurried trip to Cambridge to see some of Lindley's material (all preserved there but the *Orchidaceae*). Through the kindness of Dr. F. T. Brooks of the Botany School and the cordial assistance of Dr. J. G. Hawkes of the Imperial Institute of Genetics and Plant Breeding, my stay was made most interesting and profitable. A short visit with Mrs. Agnes Arber, who has done outstanding work, especially on the Monocots, was a very pleasant occasion in Cambridge too, planned for me by Mr. W. T. Stearn of the Royal Horticultural Society.

By the first of January, 1947, the period allotted for the project had passed but some summer vacation-time not used in 1946, made possible a short trip to Geneva and then a few days in London to study at the herbarium of the Linnean Society before departure.

My purpose in Geneva was chiefly to photograph DeCandolle's

types in *Begonia* and *Desmodium*, kept separately there, in the order of the Prodromus. In a very short two weeks it was possible only to photograph the specimens (about 200), take very brief notes and make a firm resolve to return really to study more of the fascinating material and to become better acquainted with Geneva, a particularly interesting city historically (to say nothing of its very numerous wonderful book-shops). My stay in Geneva was made especially pleasant by the help of Dr. Baehni, Director of the Conservatoire et Jardin Botaniques, and the Secretary-librarian, Mlle. Nelly Dubugnon, who wrote innumerable notes in French, to ensure my not getting lost, and performed many other kind services. It was most interesting also to meet in Geneva Dr. Hochreutiner, former director of the Conservatoire, a most gracious gentleman, and Dr. J. C. Willis of "Age and Area" fame, then putting the final touches on a new work.

Returning to London in the last week of January, it was necessary to close off some unfinished bits at the British Museum, collect my negatives, which the officers of the Museum had kindly arranged to have developed for me, and to spend a few days at the Linnean Society of London. The devoted Assistant-Secretary of the Society, Mr. Spencer Savage, made working there a most interesting and stimulating experience, and the privilege of working on the herbarium as well as Linnaeus' own books, with his annotations, was a very great one.

My departure from London was made at the time of the beginning of one of the most severe winters there recorded. The low temperatures, plus the restrictions in use of electricity and fuel imposed soon thereafter, would have made photography impossible; so, although my time was all too short, an extension then would not have greatly helped.

It is quite impossible here to express adequately the real significance of this short journey to a few of the older, historical botanical collections abroad. Those who helped, here named and unnamed, both botanists and others of whom there were very many, have made a positive contribution to the accuracy and authenticity of the new edition of Gray's Manual. To all these friends this brief note is a small token of my appreciation and the gratitude of the senior author, Professor Fernald, and myself.

Part II. Some Linnaean Species (Plates 1097–1102)

Pteris atropurpurea L. Sp. Pl. ii. 1076 (1753). The specimen so marked in the Linnaean Herbarium is the plant currently interpreted as that species. The first sentence in the Linnaean description might or might not refer to this plant. The Gronovian diagnosis seems to refer to *Pellaea glabella* Mett., but the Gronovian collection is not available. Since Linnaeus's specimen, annotated by him, is the pubescent plant, *P. atropurpurea* of authors generally, it is best not to disturb the present concept. Linnaeus's "stipes nitidus" does not hold for this plant.

Potamogeton pusillus L. = *P. panormitanus* Bivona-Bernardi, var. *major* G. Fischer. As pointed out in Rhodora xlii. 246 (1940) Dandy and Taylor indicated (in Journ. Bot. lxxvi. 91 (1938)) that the type of *Potamogeton pusillus* L. Sp. Pl. i. 127 (1753) has been regularly misinterpreted and that it is actually the later published *P. panormitanus* Biv. Nuove Piante ined. Barone Ant. Biv.-Bern. pub. del Figlio Andrea, 6 (1838). They did not make any differentiation between the two varieties of *P. panormitanus* which in America, at least, are very definite: var. *major* G. Fischer, Berichte Bayer. Bot. Gesells. xi. 109 (1907), and var. *minor* Biv. l. c. The former, with the larger or primary leaves 1–3 mm. wide, was illustrated in Fernald, Mem. Gray Herb. iii. pls. ix, xxix, fig. 7, xxxiii, fig. 4 and xxxix, fig. 10 (1932). The latter, with the larger leaves only 0.3–1 mm. wide and relatively short, was illustrated (Fernald l. c.) in plates x, xxix, fig. 8 and xxxiii, fig. 5. Until it could be determined which of these plants is matched by the Linnaean type of *P. pusillus* it was inadvisable to transfer either of the varietal names. It is now established that the type of *P. pusillus* is identical with *P. panormitanus* var. *major;* this necessitates the new combination:

P. pusillus L., var. **minor** (Biv.) comb. nov. *P. panormitanus* Biv. var. *minor* l. c.; Gussoni, Fl. Sic. Syn. i. 207 (1842); G. Fischer l. c.

Andropogon Ischaemum L. Sp. Pl. ii. 1047 (1753). The plant which Linnaeus labeled "11 Ischaemum" is *A. Gerardi* Vitm. (*A. provinciale* Lam. non Retz.), native in North America and cultivated and probably escaped in southern France. *A. Ischaemum,* as described and generally understood, is a wholly

different species, native to central and southeastern Europe, Asia and Africa and is the plant to which all the references cited by Linnaeus apply. The identity of *A. Gerardi* was discussed in Rhodora xlv. 255 et seq. (1943).

Cyperus alternifolius L. Mant. 28 (1767), "*Habitat in* Virginia." Cited by C. B. Clarke in Journ. Linn. Soc. xxi. 130 (1884) in his paper *On Indian Species of Cyperus* with the range given as "Madagascar". There seems to be no question about the identity of the plant, which is not known in America.

Juncus nodosus L. Sp. Pl. ed. 2, 466 (1762). The material under this name is as mixed as were Linnaeus's bibliographical citations. The two specimens marked by Linnaeus as *J. nodosus* are (1) characteristic *J. scirpoides* Michx. (specimen no. 449.16) and (2) the little stoloniferous northern plant which regularly passes as *J. nodosus* (specimen no. 449.17). By some of the early authors *J. nodosus* was taken up in the sense of *J. scirpoides* and the latter cited as a synonym. Since, however, the brief diagnosis applies better to the second plant (no. 449.17), which for more than a century has been regularly treated as *J. nodosus*, it would be superfluous to interpret the species as intended primarily for *J. scirpoides*.

The Type of Celtis occidentalis L., our plates 1097, 1098. —*Celtis occidentalis*, one of the most variable and taxonomically difficult of species, was defined by Linnaeus, Sp. Pl. ii. 1044 (1753), as follows:

occidentalis. 3. CELTIS foliis oblique ovatis serratis acuminatis.
Celtis procera, foliis ovato-lanceolatis serratis, fructu pullo. *Gron. virg.* 195.
Lotus arbor virginiana, fructu rubro. *Raj. hist.* 1917.
Habitat in Virginia. ♄
Folia *tenera, ovato-lanceolata, parum pubescentia; adulta lato-ovata, acuminata, acumine & basi integerrima, ceterum serrata, nuda, nervoso-venosa, latere postico duplo minore.*

It will at once be noted that in the four-line new description by Linnaeus he obviously had two quite different plants confused: (1) "Folia *tenera, ovato-lanceolata, parum pubescentia*"; (2) "*adulta lato-ovata, acuminata, acumine & basi integerrima, ceterum serrata, nuda, nervoso-venosa, latere postico duplo minore*". Furthermore, the quotation from Ray said "fructu rubro"; that

from Gronovius, which obviously coincided with the first part of the longer Linnaean description with "foliis ovato-lanceolatis", had "fructu pullo".

Recent interpretation of *C. occidentalis* and its varieties started with Sargent in Bot. Gaz. lxvii. 217, 218 (1919). There Sargent gave the following definitions.

> Celtis occidentalis L.—"On what is usually considered the type of this species the leaves are broadly ovate, acute or short-acuminate at apex, obliquely rounded at base, coarsely or finely serrate, smooth on the upper surface, glabrous or sparingly pilose along the midribs and veins below, thin, not conspicuously venulose; petioles glabrous or rarely puberulous. The fruit is borne on glabrous or rarely puberulous pedicels much longer than the petioles and is subglobose, ellipsoidal, or slightly obovoid, and 9–10 mm. in diameter; the stone is only slightly reticulate. The branchlets are glabrous or occasionally pubescent."
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> Var. canina.—". . . Differing from the type in the usually narrower long-acuminate leaves.
>
> "Extreme forms of this variety look very distinct, but trees with leaves intermediate between these and those of the typical form are common. The fruit varies as in the type from subglobose to obovoid, and there seems little difference in the length of the pedicels, which are always longer than the petioles. The leaves are usually glabrous, but on some of *Bush's* Missouri specimens the midribs and veins are pilose on the lower surface and the petioles are pubescent, as in the variety *crassifolia* . . . "
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> "Var. crassifolia Gray, Man. ed. 2, 397. 1856.—*C. crassifolia* Lamarck, Encycl. Meth. **4:** 138. 1797.—Differing from the type in its usually narrower, acuminate, thicker leaves, often more coarsely serrate or nearly entire, scabrate on the upper surface and pilose below along the midribs and veins.
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> "In this form the petioles are usually villose-pubescent, but occasionally are quite glabrous; the pedicels are slightly villose, and the branchlets are glabrous or pubescent."

At the same time Sargent took up for the tree of the southern Coastal Plain, which extends northward abundantly to the James River and inland northward in the Mississippi basin, the name *C. laevigata* Willd. of which, as Sargent said on his page 222,

> "when it grows under favorable conditions, is a tree sometimes 30 m. high, with somewhat pendulous branches and slender, glabrous, red-brown branchlets. The leaves are thin, usually oblong-lanceolate, long-pointed and acuminate at apex, unsymmetrically rounded and often oblique or cuneate at base, frequently more or less falcate, entire or furnished with a few teeth usually toward the apex, green on both surfaces, glabrous, smooth or occasionally scabrate above. The fruit is bright orange-red on pedicels shorter or slightly longer than the petioles."

Sargent recognized (p. 223) *C. laevigata*, var. *Smallii* (Beadle)

Sarg., in which the leaves of the fertile branchlets are constantly serrate, as well as some other variations of this often red-fruited species from farther to the southwest.

In his Manual (ed. 2) 318, 319 (1922), Sargent placed *C. occidentalis* with "fruit dark purple" under a heading "fruit on pedicels much longer than the petioles" and his fig. 289 thus illustrated it; while *C. laevigata* came under the general heading "fruit on pedicels shorter or only slightly longer than the petioles" the fruit being described as orange-color or yellow. The artist, however, showed the fruiting pedicels two or three times as long as the subtending petioles!

When the material which Linnaeus had before him is checked it is significant that the specimen, our PLATE 1097, FIG. 1, which he personally marked as species "3 K C. occidentalis", the specimen, collected by Kalm and now numbered in the Linnaean Herbarium 1209.4, has the fruiting pedicel scarcely as long as the petiole. This is the specimen which supplied the second portion of the Linnaean description, "*adulta lato-ovata*", etc. The citation from Ray with "fructu rubro" is not good for a species with purple-black fruit and may be passed as not typifying *C. occidentalis.*

The Gronovian account of "Celtis procera, foliis ovato-lanceolatis serratis, fructu pullo" is supported by a beautiful sheet in the Gronovian herbarium at the British Museum (our PLATE 1098, FIG. 1) which is clearly of *C. laevigata,* var. *Smallii,* a very characteristic tree which reaches its northern limit in Clayton's territory. This tree, with very thin oblong- or ovate-lanceolate, long-attenuate leaves, formed the basis of the first portion of the Linnaean description "Folia *tenera, ovato-lanceolata*". In the Linnaean Herbarium, but not bearing Linnaeus's identifications, there is a branch (1209.5) in anthesis (with one flower) the sheet bearing in Gronovius's hand "Celtis fol. ovato-lanceolatis", etc., but with the "fructu atro purpurascato subdulci". Since this specimen was not marked by Linnaeus and since most of its elongate leaves have the tips broken, it is of secondary importance, but the long-attenuate tips of the two unbroken upper leaves are readily matched by those of modern specimens of *C. laevigata,* var. *Smallii.* The Gronovian "fructu atro purpurascato" certainly was not deduced from the single

flower. At any rate, this specimen, without Linnaeus's identification, cannot be taken as the type of *Celtis occidentalis*. Since the one specimen which bears Linnaeus's identification and is certainly the basis of the description of the adult branch, while the far handsomer Clayton specimen of the tree "folia *tenera*, *ovato-lanceolata*" and the unidentified fragment in the Linnaean Herbarium are characteristic *C. laevigata*, var. *Smallii*, it seems only right to treat the first (1209.4) as the TYPE of *Celtis occidentalis*. This decision coincides with that of Mr. Savage in a letter to us, under date of 30 May, 1947, which refers unequivocally to "The type-specimen of *Celtis occidentalis* L. in Hb. Linn. no. 1209.4".

At the time the junior author made the photographs of *Celtis* in the Linnaean Herbarium the severe winter of 1946–47 was coming on in London and the resulting numbness of fingers made it impossible to ascertain clearly whether the leaves of 1209.4 were smooth or scabrous. This point is now settled for us in Mr. Savage's letter, written when the weather in London was "almost unbearably hot", Mr. Savage stating explicitly that "the leaves of this specimen are scabrous". The type of *Celtis occidentalis* is, then, as already surmised, identical with *C. crassifolia* Lam., Encycl. Méth. iv. 138 (1796), Lamarck's TYPE shown as our PLATE 1097, FIG. 2.

The thin- and smooth-leaved tree or shrub which has recently been passing as true *C. occidentalis* must be called *C. occidentalis*, var. *pumila* (Pursh) Gray, Man. ed. 2: 397 (1856), for this was based on *C. pumila* Pursh, Fl. Am. Sept. i. 200 (1814). This interpretation of *Celtis pumila* needs explanation, since, by the treatments of Sargent, Rehder and their followers, *C. pumila* is supposed to be the shrub or small tree of exposed or very bleak habitats with the leaves of the fertile branchlets entire or essentially so and the small and spherical fruits bright red or reddish to brown and with relatively small stones, whereas the fruit of the serrate-leaved and mostly taller *C. occidentalis* is larger, slightly longer than broad to spherical, and varying in the different trends from orange or amber-color to purple-black, the stones positively larger than in so-called *C. pumila*. The generally accepted but erroneous interpretation is well stated in the key and description in Rehder, Man. Cult. Trees and Shrubs, ed.

2: 184, 185 (1940). His *C. pumila* there comes under the first capital A of his key, "Leaves entire or occasionally with few teeth . . . : stone pitted", while *C. occidentalis* comes under AA "Leaves serrate". His *C. pumila* has its fruit described as "purple or tan-color". Deam's Flora of Indiana (1940), based upon a very close field-study of the plants of his region, thus separates *C. occidentalis* and the traditional *C. pumila*. In his key on page 392 the following is given for *C. occidentalis*:

> Margins of leaves of fruiting branchlets and shoots sharply serrate all around to the base; leaf blades of an ovate to broadly ovate type, oblique at base, sometimes strongly so, those of fruiting branchlets 5–15 cm long; pedicels of fruit much longer than the petioles; nutlets 6–8 mm long; small or large trees.

This opposed to

> Margins of leaves of fruiting branchlets usually entire, or some with a few teeth on one side or with a few teeth on both sides but never serrate on either side to the base; margins of leaves of vegetative branchlets and shoots similar to those of fruiting branchlets, or with the margins serrate nearly all around but never serrate to the base; pedicels of fruit shorter or only slightly longer than the petioles; nutlets 5–6 mm long,

this definition covering both *C. laevigata* and *C. pumila*. The latter is separated by Deam as follows:

> Leaves mostly of an ovate-lanceolate type, sometimes ovate to broadly ovate or rarely oblong-lanceolate, generally thick and yellow green beneath, generally smooth but sometimes rough above; blades extremely variable in size and shape, mostly 3–10 cm long and 2–6 cm wide, usually about half the maximum size; branchlets usually more or less pubescent; pedicels shorter or longer than the petioles; mature fruit (collected in October) a dark cherry red; trees usually 1–2.5 m high, but sometimes 4–6 m high and up to 1 dm in diameter near the base; of a dry sandy, gravelly or rocky habitat.

Deam's very detailed description is of *C. pumila* as nowadays generally interpreted. Unfortunately, however, recent authors seem not to have paid very close attention to Pursh's own account. Otherwise they would not emphasize the entire leaves and the small and spherical purple or tan-color or cherry-red drupe. As a matter of fact, wherever the senior author has seen the entire-leaved so-called *C. pumila* its small spherical fruits have always been red to red-orange when ripe. Pursh's brief account was as follows:

> *pumila.* 3. C. foliis ovatis acuminatis aequaliter serratis basi inaequalibus utrinque glabriusculis: junioribus tantum pubescentibus, pedunculis subtrifloris, fructu solitario.

On the banks of rivers: Maryland and Virginia. ♄. May. *v. v.* A small straggling bush; berries ovate, black.

The small to medium-sized tree or shrub with relatively thin and smooth serrate leaves, which has passed as true *C. occidentalis*, is obviously what Pursh described. Fortunately Pursh's own material (the TYPE), with his own identification clearly written, is preserved in the Pursh herbarium at the Academy of Natural Sciences of Philadelphia. We are indebted to the generous interest of Mr. Bayard Long for a photograph of it, ×5/7 (PLATE 1098, FIGS. 2 and 3) and to Dr. Francis W. Pennell for a transcript of the label, Dr. Pennell remarking that Pursh's labels are the most complete of any on old collections preserved at the Academy. Pursh collected this specimen "in 1806 on his Virginia trip made for Dr. B. S. Barton".

The shrub or small tree of usually exposed habitats which has erroneously been passing as *Celtis pumila* is *C. tenuifolia* Nutt. Gen. N. Am. Pl. i. 202 (1818). Although Nuttall thought his new species might be the *C. pumila* of Pursh, he definitely expressed doubt. His new name was not, then, a superfluous substitute but that of the shrub which erroneously passes as *C. pumila*. Here is Nuttall's description:

3. *tenuifolia. C. pumila*, Pursh 1. p. 200? A low bush, in the mountains of Virginia, flowering at the height of 2 feet. Leaves nearly as broad as long, now and then without serratures, often cordate-ovate, very little acuminated and almost perfectly smooth on both sides. Berries solitary, brown and glaucous.

The extreme with leaves thicker, more pubescent, and harshly scabrous above is:

C. TENUIFOLIA Nutt., var. **georgiana** (Small), comb. nov. *C. georgiana* Small in Bull, Torr. Bot. Cl. xxiv. 439 (1897). *C. pumila*, var. *georgiana* (Small) Sargent in Bot. Gaz. lxvii. 227 (1919).

In some cases, as in the work of Deam, we find *Celtis pumila* ascribed to "(Muhl.) Pursh"; in others called *C. occidentalis*, var. *pumila* Muhl. The evident basis for such citations is the *nomen nudum* "*C.* occidentalis, B, pumila dwarf Pens. fl. Maio." of Muhl. Cat. 95 (1813). Without any differentiation, the word "dwarf" being a mere translation of "pumila", Muhlenberg's name must be treated as a *nomen nudum*.

Another name which may sometime have to be taken up is that of Persoon, Syn. i. 292 (1805), his *C. occidentalis* "β.? *tenuifolia*, fol. tenuioribus minus acuminatis, dentib. majoribus basi magis rotundatis; vid. Enc. bot. l. c. p. 137 et 138. Cresc. in Ludoviscana; colitur in H. P. An distincta?". This is based on *C. occidentalis* "β. *eadem? foliis tenuioribus minùs acuminatis*" of Lam. Encycl. Méth. iv. 137 (1796). Lamarck further saying (p. 138):

> L'arbre β, dont je ne connois ni les fleurs ni les fruits, est originaire de la Louisiane, & cultivé également au jardin des plantes. Il a les feuilles moins acuminées, plus minces, dentées plus grossièrement, un peu plus arondies à la bâse. La gelée a d'ailleurs beaucoup de prise sur lui, & le fait ordinairement périr tous les ans jusqu' à la racine, au moins dans notre climat. N'est-il qu'une simple variété du *celtis occidentalis*, ou bien doit-il former une espèce particulière? (*V. v. 5. Flor. & 5. Fr.*)

It is not improbable that this variety may prove to be *C. laevigata* Willd., var. *Smallii* (Beadle) Sarg. l. c. 223 (1919). Until this matter is settled Sargent's varietal name should stand.

An early varietal name for typical *Celtis laevigata* Willd., the name to be taken up if entire-leaved typical *C. laevigata* is treated as a variety of *C. occidentalis* (a course for which there is logical argument, in view of the frequent overlapping of characters) is *C. occidentalis* L., var. *integrifolia* Nutt. Gen. i. 202 (1818). This varietal name was unjustifiably cited in the synonymy of *C. mississippiensis* Bosc ex Spach (1841) as "C. integrifolia, *Nutt.*" by Gray, Man. ed. 2: 397 (1856), thus unfortunately saddling upon Nuttall a binomial which he apparently did not make, Nuttall having used only the varietal combination. The only legitimately published *C. integrifolia* seems to be that of Lam. Encyc. Meth. iv. 140 (1796), with "*foliis ovato-subrotundis*" and coming from Senegal. Obviously this has nothing to do with *C. laevigata*, although *Index Kewensis*, with uncanny lack of understanding, refers it to the synonymy of the narrow-leaved American *C. mississippiensis* Bosc ex Spach (1841), a synonym of *C. laevigata* Willd. (1811). Even if the round-leaved *C. integrifolia* Lam. (1796) of Senegal were forced into the narrow-leaved *C. mississippiensis* of 1841 or *C. laevigata* of 1811 (reduced by Ind. Kew. to *C. mississippiensis*), it is not clear on what basis this indispensable but too often misleading work was com-

piled. *Celtis* was obviously as puzzling to its editors as to those who have to hunt for its morphological characters. Another name for entire-leaved typical *C. laevigata* Willd. (1811) is *C. longifolia* Nutt. N. Am. Sylva, i. 134, t. xl (1842), described in detail, beautifully illustrated and based on "*C. occidentalis* β. *integrifolia*, NUTT. Gen. Am. vol. 1. p. 202. (not of LAMARCK.)," Nuttall giving the tree a new name because of the earlier *C. integrifolia* Lam. (1796). Nuttall's *C. longifolia* has not made its way into Index Kewensis, presumably because it was thought to be the same as *C. longifolia* Raf. Atl. Journ. i. 177 (1833), a tree of "*Texas & Arkanzas*", which, from the description, "Fol. distichis, elongato oblongis acum. basi obliq. truncatis, equal. serratis" etc. was presumably *C. laevigata*, var. *Smallii*.

This discussion of nomenclatural and taxonomic problems is only typical of much which must be cleared before the exact names and identities of our plants (and especially the ligneous ones) can be finally settled. To the problem of evaluating the often fluctuating morphological characters is added the interpretation of authors of the past. The present authors do not deceive themselves into thinking that the problems of eastern American *Celtis* are finally settled. They may have done something to clear away some of the obstacles.

SALICORNIA VIRGINICA L. Sp. Pl. i. 4 (1753) as *virginia*. *S. herbacea*, β. *virginica* (L.) L. Sp. Pl. ed. 2: i. 5 (1762). *S. ambigua* Michx. Fl. Bor.-Am. i. 2 (1803).

Although Linnaeus confused the characteristic Atlantic North American perennial with a quite different plant of Europe, his brief diagnosis and his quoted description were both based on Virginian material from Clayton, described in Gronovius, Fl. Virg. ii. 129 (1743). The Gronovian account was clear and to the point:

> SALICORNIA *caulium ramorumque articulis apice bicornibus.*
> Salicornia erecta ramosa, caule ad imum nudo, plerumque rubente. *Clayt. n. 527 & 667.*

Linnaeus wrote

> *virginia.* 3. SALICORNIA articulis apice compressis emarginatis bifidis.
> Salicornia caulium ramorumque articulis apice bicornibus. *Gron. virg.* 129.
> *Habitat in* Virginia, *& ad* Salinas Saxoniae. ⊙

In Species Plantarum, ed. 2, i. 5 (1762) Linnaeus corrected the spelling of the name but reduced the Virginian species to varietal rank under the annual *S. herbacea* L. as *S. herbacea* β. *virginica*, giving merely the description from Gronovius but adding the comment: "*Virginica* β. *ad Salinas Saxoniae frequentissima, vix ac ne vix distincta est species; articuli in salsis enim magis emarginati evadunt.*"

Even though Linnaeus confused the quite different plant of Saxony with the plant described by Gronovius from Clayton specimens and erroneously inferred that the Clayton specimens were annual, the collection of Clayton, preserved in the Gronovian Herbarium at the British Museum of Natural History, must stand as the TYPE of *Salicornia virginica*, especially since Linnaeus had no material in his own herbarium. This Clayton sheet, bearing the brief diagnoses above quoted from Gronovius and the nos. 572 and 667 (the former evidently misquoted by Gronovius as 527), consists of three branches, two of them forking from below the middle and with very prominent 2–horned scales ("caulium ramorumque articulis apice bicornibus"), the third a long and simple stem with few simple branches at summit ("erecta ramosa, caule ad imum nudo"). This material is very readily matched by specimens of *S. ambigua* Michx., a species which Clayton would have had great difficulty in avoiding along the coastal sands of Virginia.

POLYGALA CRUCIATA L., var. **aquilonia,** var. nov., TAB. 1100, planta 0.5–2.5 dm. alta, simplex vel divergenter ramosa; foliae verticillis primariis 3–5 (–7), foliis spathulatis vel spathulato-linearibus; racemis sessilibus vel breviter pedunculatis (pedunculo ad 5 mm. longo) primariis 0.7–1.5 cm. crassis; bracteis persistentibus 1.5–2 mm. longis; alae late deltoideo-cordatae, quam latis quam longis, 2.5–4 mm. longis in apice subulato, 0.5–1 mm. longo; seminibus ellipsoideo-obovoideis rugulosis.—Southern Maine to Virginia, there passing to typical *P. cruciata;* inland from northern Ohio to northern Illinois and Minnesota, south to mountains of Alabama and Tennessee. TYPE from inner edge of salt-marsh, Stratford, Connecticut, August 30, 1896, *E. H. Eames* in Herb. Gray.

In general, botanists have interpreted the more northern var. *aquilonia* as true *Polygala cruciata*, and the wide-ranging southern *P. cuspidata* Hook. & Arn. in Hook. Journ. Bot. i. 194 (1834), not DC. (1824), has been treated as a fairly distinct and larger

variety, *P. cruciata*, var. *cuspidata* (Hook. & Arn.) Wood, Class-bk. ed. of 1861: 296 (1861) or var. *ramosior* Nash ex Robinson in Gray, Syn. Fl. i[1]. 458 (1897). Small, furthermore, considered the latter a distinct species, *P. ramosior* (Nash) Small, Man. 771 (1933).

The Linnaean *Polygala cruciata*, Sp. Pl. 706 (1753), was based on two references, one of which, Gron. Virg. 80, contains a citation to a Clayton specimen, no. 157. This specimen, now in the British Museum, was examined and photographed. It consists of two depauperate plants with all the tendencies of the southern variety, although not quite approaching most such material in the size of its parts. Its leaves are linear-spatulate and its nodes numerous (for its size). On the same sheet with the Clayton collection is mounted a collection, also somewhat depauperate, from Maine. The latter plants show equally well the characteristics of var. *aquilonia*, with divergent branches and spatulate to narrowly oblanceolate leaves. The two collections could hardly be considered the same and better developed material makes clear that the tendencies here displayed, when fully developed, characterize real varieties. The Clayton material, immature though it is, unquestionably represents the more southern branch of the species, typical *P. cruciata*.

Although in eastern Virginia typical *Polygala cruciata* and var. *aquilonia* obviously merge, the material from Florida to eastern Texas, thence northward into eastern North Carolina (and largely eastern Virginia) seems to be well distinguished from the more northern series. The following characters may be noted:

P. CRUCIATA (typical), our PLATE 1099. *P. cuspidata* Hook. & Arn. in Hook. Journ. Bot. i. 194 (1834), not DC. (1824). Var. *cuspidata* (Hook. & Arn.) Wood, Class-bk., ed. of 1861: 296 (1861) Var. *ramosior* Nash ex Robinson in Gray, Syn. Fl. i[1]. 458 (1897). *P. ramosior* (Nash) Small, Man. 771 (1933). Plant 1–5 dm. high, simple to much branched, the primary axis with 5–12 leaf-bearing nodes; leaves linear-spatulate or linear-oblanceolate, firm, the larger ones 1.5–3 (–4) mm. wide; racemes sessile or on peduncles up to 4 cm. long, the leading raceme before falling off of lower flowers (1–) 1.5–4.5 cm. long and 1.2–2 cm. thick; persistent bracts 2–3 mm. long; wings longer than broad, their blades 3.5–5.5 mm. long, tapering to an awn 1.5–3 mm. long; seed ellipsoid, faintly rugulose.

Var. AQUILONIA, PLATE 1100. Plant 0.5–2.5 dm. high, simple or divergently few-branched, the primary axis with 3–5 (–6) leaf-bearing nodes; leaves spatulate to narrowly oblanceolate, herbaceous, the larger ones (2–) 3–7 mm. wide; racemes sessile or on very short (up to 5 mm.) peduncles, the leading raceme before falling of flowers 0.7–3.5 cm. long and 0.7–1.5 cm. thick; persistent bracts 1.5–2 mm. long; wings about as wide as long, 2.5–4 mm. long, with subulate tip 0.5–1 mm. long; seed ellipsoid-obovoid, coarsely rugulose.

True southern *Polygala cruciata* seems never to occur in subsaline habitats but to prefer wet pineland or pine-barren or boggy savannas, Chapman, Fl. So. U. S. 84 (1860) assigning it to "Pine-barren swamps" and Small, Fl. to "Low pinelands and swamps". The 41 collections in the Gray Herbarium which have clear indication of habitat give the following score: moist pineland, pine-barren swamps or flat pineland, 14; savanna, sphagnous swale or sphagnous bog, 15; swamp, 3; meadow, 5; and moist soil, river-swamp, low ground and grass-palmetto land, 1 each. On the other hand the generally more northern or inland var. *aquilonia* is a plant of usually less saturatedly wet habitats and from Delaware northward it is partial to the outer coastal or coastwise region, even the upper borders of salt-marshes. Thus, in their report on the Flora of the Boston District, Knowlton and Deane recorded it in Rhodora xxi. 81 (1919) as "not reported from western towns, but occasional throughout the towns nearer the coast". In fact, of the 90 collections from Massachusetts before us the farthest inland is from Westford, only about 25 miles from the sea. Similarly, the Connecticut Botanical Society's Catalogue of the Flowering Plants and Ferns of Connecticut says: "Occasional or frequent near the coast, but rare or wanting inland". For the whole of New York state House could say only "In sandy swamps and depressions and the borders of salt marshes. Frequent or common on Long Island and Staten Island", not far inland. Again, Stone, reporting on the Plants of Southern New Jersey, says: "Common in damp ground in the Pine Barrens and locally in the Middle, Coast and Cape May districts, occurring at a few stations north of our limits, but all within the coastal plain". From the 70 collections before us from New England, which have the habitat clearly indicated, we get the following score: border of salt-marsh or sea-shore, 10; sandy, gravelly or peaty pond-margin, 31; meadow or low field, 13; cranberry-bog or boggy swale, 8; grassy swamp, damp sandy soil or sandy swamp, 2 each; dry field and damp woods, 1 each.

Farther inland (as in the case of many other coastwise species) var. *aquilonia* occurs near the Great Lakes, thence southward along the mountains to northern Alabama: swamps near Henderson, Henderson Co., North Carolina [between Blue Ridge and

Pisgah Ridge], *Biltmore Herb.* no. 731[d]; Pine Knot, McCreary Co., Kentucky [Pine Mts. to Cumberland Plateau], *H. J. Rogers*, no. 39; 6 miles east of Crossville, alt. 2300 ft., Cumberland Co., Tennessee (Cumberland Mts.), *Svenson*, no. 4181; Sand Mountain, Jackson Co., Alabama, August 29, 1938, *Lillian V. Porter*. Extending locally inland from the Gulf States true *P. cruciata* reaches south-central Tennessee: Coffee Co., alt. 1100 ft., *Svenson*, no. 4258; Van Buren Co., *Svenson*, no. 9391; Grundy Co., *Svenson*, no. 8930.

From Blake's synonymy in the North American Flora it might be thought that *Polygala missurica* Raf. New Fl. iv. 89 (1838) should be taken up for the inland phase of *P. cruciata*, var. *aquilonia;* but it is probable that there was some misinterpretation of Rafinesque's plant. On his pp. 87 and 88 Rafinesque subdivided *Polygala* into 10 subgenera, with subgenus

"5. Sexilia R. stamens 6 sessile, corolla bilabiate cristate, type P. verticillata and all whorled species, chiefly annuals".

His *P. missurica* was described as follows:

"966. Polygala (Sexilia) missurica Raf. stem branched diffuse 4gone, leaves quaternate and opposite broad lanceolate smooth, base acute, end mucronate; spikes terminal oblong imbricate—in the prairies of Missouri and Illinois, 3 to 4 inches high, leaves larger and broader than in others, flowers white, not in filiform spikes. Annual".

Since subgenus *Sexilia* was typified by *Polygala verticillata* and the only additional species definitely named by Rafinesque in this place was his *P. missurica* with *lanceolate* (not oblanceolate nor spatulate) *leaves* and *white flowers* and since the ordinarily green- to bronze- or purple-flowered *P. cruciata* has never been recorded from Missouri (at least not recorded by Palmer & Steyermark), it would seem that Rafinesque was describing a white-flowered, lanceolate-leaved variety of *P. verticillata* with "spikes . . . oblong". Just such a plant is *P. verticillata*, var. *sphenostachya* Pennell in Bartonia, xiii. 9 and 12 (1931) which is represented by specimens before us from "sandy prairie", Havana, Illinois, *Gleason;* "sterile prairie", Stark Co., Illinois, *V. H. Chase*, no. 198; "prairies" Leeds, North Dakota, *Lunell;* "common on prairies", Black Hills, *Forwood;* and by material from Missouri. At least *P. missurica* can hardly be *P. cruciata*.

Ordinarily the racemes of var. *aquilonia* are greenish, reddish or purple-tinged. Very rarely an albino occurs. This is

Var. AQUILONIA, forma **alba** (Oakes), comb. nov. *P. cruciata* b. *alba* Oakes in Hovey's Mag. vii. 185 (1841).

HYPERICUM CALYCINUM L. Mant. 106 (1767). The habitat of this species was cited with doubt by Linnaeus as in America septentrionali. The species is, however, native in the Old World and the type-specimen is matched by a large amount of herbarium-material.

HYPERICUM PROLIFICUM L. l. c., our PLATE 1101, FIGS. 1–3. The material under this name in the Linnaean Herbarium was discussed in some detail by Svenson in RHODORA, xlii. 9 (1940). Svenson's decision that sheet no. 20 must be taken as the TYPE of *H. prolificum* L. is correct, as is his statement that sheets 22 (our FIG. 4), 23 and 24 represent *H. prolificum* in the sense of American authors generally, not Linnaeus (except in very small part, the Gronovian reference). In the original account Linnaeus included two very different plants:

prolificum. 31. HYPERICUM floribus trigynis, caule tetragono fruticoso, foliis lanceolato-linearibus, floribus primordialibus sessilibus.

Hypericum floribus semitrigynis, staminibus corolla breuioribus, caule fruticoso semperuirente. *Gruan. virg. 112.*

Habitat in America *septentrionali.* ♄.

Caules *recti, purpurascentes.* Folia *saepius reuoluta, vnde angusta Rosmarini.* Foliola *ramulorum primordia, ex alis plurima.* Panicula *parua, terminalis.* Flores *primae secundaeque dichotomiae sessiles; reliqui terminales, pedunculati, numero rarius vltra 7.* Stamina *petalis non longiora.*

That the quotation from Gronovius (misprinted "*Gruan.*"), Fl. Virg. ed. 2: 112 (1762) and the further notes given by Gronovius referred to the plant familiarly known as *H. prolificum* (our FIG. 4) has already been noted by Gray and others. The difficulty is, that the plant described in detail (our FIGS. 1–3) "Folia *saepius reuoluta, vnde angusta Rosmarini.* Foliola *ramulorum primordia, ex alis plurima* . . . Stamina *petalis non longiora*", is the one which Linnaeus had in his herbarium as "*proliferum*" with an additional memorandum of some of the characters given in his description. His published specific name *prolificum* was, obviously, from the axillary fascicles ("Foliola . . . *ex alis plurima*").

The relationship of sheet no. 20 seems, from examination of the inflorescence and the comparative length of stamens and petals to be, as Svenson indicated, possibly with what we have considered true *H. prolificum* rather than with *H. densiflorum.* The extreme variation in leaf-characters, however, seems to us to indicate a differentiation more basic than the mere aberrancy from *H. prolificum* which Svenson considers it. In the vast amount of herbarium-material available we have not been able to find anything which can be identified unquestionably with the Linnaean sheet number 20. The only name which we have found in the literature which is possibly applicable to *H. prolificum* sensu Gray, Man. (and current authors) is H. SPATHULATUM (Spach) Steud. Nomencl. ed. 2, i. 789 (1840), based on *Myriandra spathulata* Spach, Hist. Nat. Vég. v. 440 (1836)[1]. Spach's description was detailed and he cited as its basis material at Paris received from Leconte as *H. prolificum.* Asa Gray, looking up the Spach type, made the unpublished memorandum that it was *H. prolificum* (in his sense). This name of course invalidates *H. spathulatum* Keller in Engler, Bot. Jahrb. lviii. 195 (1923), based on one of Harper's numbers from Georgia which we have not seen.

FRAXINUS AMERICANA L. Sp. Pl. ii. 1057 (1753), as pointed out by the senior author in Journ. Arn. Arb. xxvii. 390, 391 (1946), was based by Linnaeus primarily on the Gronovian account and Catesby's plate. The Catesby plant is clearly of the southern Water Ash, *Fraxinus caroliniana* Mill. (1768) and the quotation from Gronovius was altered by the addition of "petiolis teretibus", a phrase which Gronovius did not use. Since the latter character is a distinctive one of the Water Ash and not of the White Ash, universally known as *F. americana,* it was naturally inferred that the Clayton specimen cited by Gronovius was of the same species as Catesby's. It was, however, pointed out that Linnaeus had in his own herbarium as *F. americana* a

[1] Unfortunately *Index Kewensis* cites *Myriandra spathulata* and other species fully described by Spach in his extended treatment of the *Hypericaceae* in his Histoire Naturelle des Végétaux, vol. 5 (June, 1836) as published only in Annales des Sciences Naturelles, Sér. 2, v. (June, 1836), a mere summary of the more extended monograph then being printed. In the briefer summary most of the species appear only as names, with reference to Spach's forthcoming "*Suites à Buffon*", the latter name used for Spach's series of monographs published in his Histoire Naturelle des Végétaux (see Pritzel, Thesaurus, entry 8805). The publication of most of the species should date from the latter work.

mature leaf of characteristic White Ash. The argument was used that only by accepting this specimen as the type could the name *F. americana* be retained in its long-established sense. It now proves, happily, that the Clayton sheet, described by Gronovius, consists of a very young branchlet of undeveloped leaves and a mature leaf of perfectly typical *F. americana*, the leaflets rounded at base and definitely whitened beneath. This mature leaf is so like the leaf in the Linnaean Herbarium that it is difficult to believe that the two were from different branchlets. The ground for maintaining *F. americana* in its traditional sense is thus vastly strengthened.

CHELONE GLABRA L. Sp. Pl. ii. 611 (1753). The uppermost leaves on the type-specimen are not measurably reduced in size as implied in Pennell's key (Scrophulariaceae of E. Temp. N. Am. 187 (1935)). Although there is some variation in leaf-size in the large number of specimens in the Gray Herbarium some modification in the key, which allows for no variation, is necessary.

CASSINE PERAGUA L.—In 1900 Loesener[1] discussed in some detail the status of the name *Cassine* L. and reviewed Linnaeus's disposition of *C. Peragua* through several of his works. He concluded that *C. Peragua* is a *nomen nudum*. Obviously, he has confused his terms, because the name was perfectly validly published. It is, however, an outstanding example of a *nomen ambiguum* as well as of a *nomen confusum!*

In the Linnaean Herbarium there are two specimens of American shrubs under the name *Cassine Peragua*. One of them (numbered 380.2) bears the name "Peragua" in Linnaeus's hand as well as an inscription by Sir James Edward Smith: "Viburnum cassinoides HB. diversum a V. cassia. HL. Viburnum laevigatum. Ait. Willd. Sp. Pl. v. 1. 1492". This plant is a vigorous sprout with narrowly elliptic and acuminate leaves, those of the leading shoot abundantly crenate-dentate. It is easily matched by narrow-leaved specimens of *Viburnum cassinoides* L.

The second specimen (numbered 380.3 and pinned to 380.2), also marked "Peragua" by Linnaeus, is a characterisftic sterile shoot with obovate, remotely dentate leaves of *Viburnum obovatum* Walt. Fl. Carol. 116 (1788). This identification has

[1] Loesener in Engl. Bot. Jahrb. xxviii². 154, 155 [footnote] (1900); and in Monog. Aquifol. in Nov. Act. Abh. der Kaiserl. Leop.-Carol. Deutschen. Akad. Naturf. lxxviii. 496 (1901).

been many times noted in the literature and there seems no good reason to doubt it; particularly since the Linnaean specimen can be well matched by a small specimen of leaves and flowers in Walter's Herbarium which agrees well with his description of *V. obovatum*, although labeled simply "Viburnum".

As Loesener showed, Linnaeus's own concept of *Cassine Peragua* was not clear. First mention of the plant by Linnaeus was in his Materia Medica, 50 [genus no. 153] (1749) where, under *Cassine* of Hort. Cliff. 72 he took up

> CASSINE vera perquam similis arbuscula, phillyreae foliis antagonistis. *Pluk. mant.* 40. *t.* 371. *f.* 3?
> LOC: Aethiopia, Carolina. *Arbor mansveta*
> PHARM: PERAGUAE Folia.
> . . . . . .
> . . . . . .

In Species Plantarum, ed. 1, Linnaeus cited his Hort. Cliff. and Materia Medica references among many others, all of which referred to an Old World plant, giving again however, the "Habitat in *Aethiopia, Carolina.* ♄".

In ed. 2 of Species Plantarum one reference of ed. 1 was removed, another reference was added and the habitat altered to read "*Habitat in* Aethiopia. ♄.". Also, in ed. 2 a new *Viburnum, V. cassinoides* was described with one of the citations being "*Mill. dict. t.* 83. *f.* 1.". In the Mantissa Altera the reference newly added to *Cassine Peragua* in Sp. Pl. ed. 2 was transferred to *C. capensis;* the Miller reference given under *Viburnum cassinoides* of ed. 2 was placed here under *C. Peragua* and the habitat revised to read "*Habitat in* Carolina, Virginia. ♄.". Also, an additional diagnosis was appended:

> Folia *petiolata, lato-lanceolata, acutiuscula, serrata absque venis elevatis.*
> Petioli *dorso decurrentes,* unde *Ramuli ancipites.*
> Corymbi *breves.*
> *Obs. caute distinguenda a* C. capensi.

The new diagnosis as well as the reference to the Miller plate seem to be based on the narrow-leaved form of *V. cassinoides* to which we are referring specimen 380.2 of Linnaeus. Although specimen 380.3 is *Viburnum obovatum*, it is clear that Linnaeus did not describe that species as his *C. Peragua*, but rather *V. cassinoides* which he had already defined under *Viburnum.*

Since the taxonomic elements of Linnaeus's *Cassine Peragua* can be disposed of by placing them in species of *Viburnum* under relatively well understood names, it would seem soundest policy to reject the name *Cassine Peragua* permanently rather than to apply it in still another sense and further increase the confusion.

RUDBECKIA LACINIATA L. Sp. Pl. ii. 906 (1753) occurs as four fairly well defined geographic varieties. True *R. laciniata* (photograph of the TYPE before us) is very coarse, up to 3 m. high, with soon reflexed ligules 2–6 cm. long; the greenish-yellow disk at first hemispherical but soon columnar and elongated to 1.5–3 cm. and becoming 1.3–2.5 cm. broad; achenes 5–6 mm. long. Its lower leaves are petioled and pinnate, with 5–7 incised or 3-lobed leaflets, the median and upper similar but sessile, the uppermost often simple. This coarse species extends from Quebec to Montana, south to Nova Scotia, New England, northern Florida, Louisiana, Texas, New Mexico and Arizona, including *R. ampla* Nels. in Bull. Torr. Bot. Cl. xxviii. 234 (1901).

In the southeastern United States most *Rudbeckia laciniata* is lower, 0.7–1.5 m. high, and more slender, with disks only 0.7–1.3 cm. thick and elongating only to 0.7–1.5 cm.; the ligules 1.5–3.5 cm. long; and achenes 3.5–5 mm. long. This southeastern series consists of three well defined varieties. The commonest, var. DIGITATA (Mill.) Fiori in Fiori & Paoletti, Fl. Anal. Ital. iii. 300 (1904), based on *R. digitata* [as *digitatis*] Mill. Gard. Dict. ed. 8, no. 6 (1768), is smooth or with the thin leaves merely scabrous, the basal and lower cauline leaves with their pinnae cut into narrowly lanceolate to almost linear segments. This variety occurs from eastern Maryland to Georgia. A photograph of the TYPE of *R. digitata* Mill., secured by the junior author, is thoroughly characteristic of the variety as here interpreted.

Var. HUMILIS Gray, Syn. Fl. N. Am. i^2. 262 (1884), is quite as slender and low as var. *digitata*, with some, usually all, the thin lower leaves ovate and uncleft or but slightly cleft into 1 or 2 pairs of broad undivided segments or leaflets, its upper leaves mostly simple and ovate or ovate-elliptic and petioled. Described as growing on "Alleghany Mountains from Virginia to Georgia and Tennessee, common in open woods, &c., at 4,000 to 6,000 feet", it has an isolated station on the Peninsula of Virginia:

floodplain of wooded swamp, near Mill Creek, 3½ miles southwest of Williamsburg, *Grimes*, no. 4600, in an area where many other montane plants are isolated; and it is also found in the mountains of Kentucky: near Poor Fork Post Office, Harlan Co., *Kearney*, no. 324.

The fourth variety is the cinereous plant of Florida, with leaves densely soft-pilose beneath, described as *R. heterophylla* Torr. & Gray, Fl. N. Am. ii. 312 (1842). In everything but its dense and short pubescence and firmer leaves it closely resembles var. *humilis*. Neither Gray, Syn. Fl., nor Small gave any characters, except the pubescence, to separate it and we can find none. The TYPE-series has simple cordate-ovate basal leaves with coarse dentation, in outline quite as in most typical var. *humilis*. Var. *heterophylla* seems to be confined to Florida, south of the slightly more northern and chiefly montane var. *humilis*. We are calling it

R. LACINIATA L., var. **heterophylla** (Torr. & Gray), stat. nov. *R. heterophylla* Torr. & Gray, Fl. N. Am. ii. 312 (1842).

THE TYPE OF RUDBECKIA HIRTA (PLATE 1102).—*Rudbeckia hirta* L. Sp. Pl. ii. 907 (1753), his species no. 3, rested in part on references to earlier authors, in part upon material actually before Linnaeus while preparing *Species Plantarum*. The treatment was as follows:

3. RUDBECKIA foliis indivisis spatulato-ovatis, radii petalis emarginatis. *hirta*
Rudbeckia, ramis indivisis unifloris, foliis ovato-lanceolatis, hirta. *Büttn. cunon.* 227.*
Rudbeckia foliis lanceolato-ovatis alternis indivisis, petalis radii integris. *Gron. virg.* 181.
Obeliscotheca integrifolia, radio aureo, umboae atrorubente. *Dill. elth.* 295. *t.* 218. *f.* 285.
Chrysanthemum helenii folio, umbone floris gradiusculo prominente. *Pluk. alm.* 99. *t.* 242. *f.* 2. *Moris. hist.* 3. *p.* 23. *Raj. suppl.* 210.
Habitat in Virginia, Canada. ♂. ♃

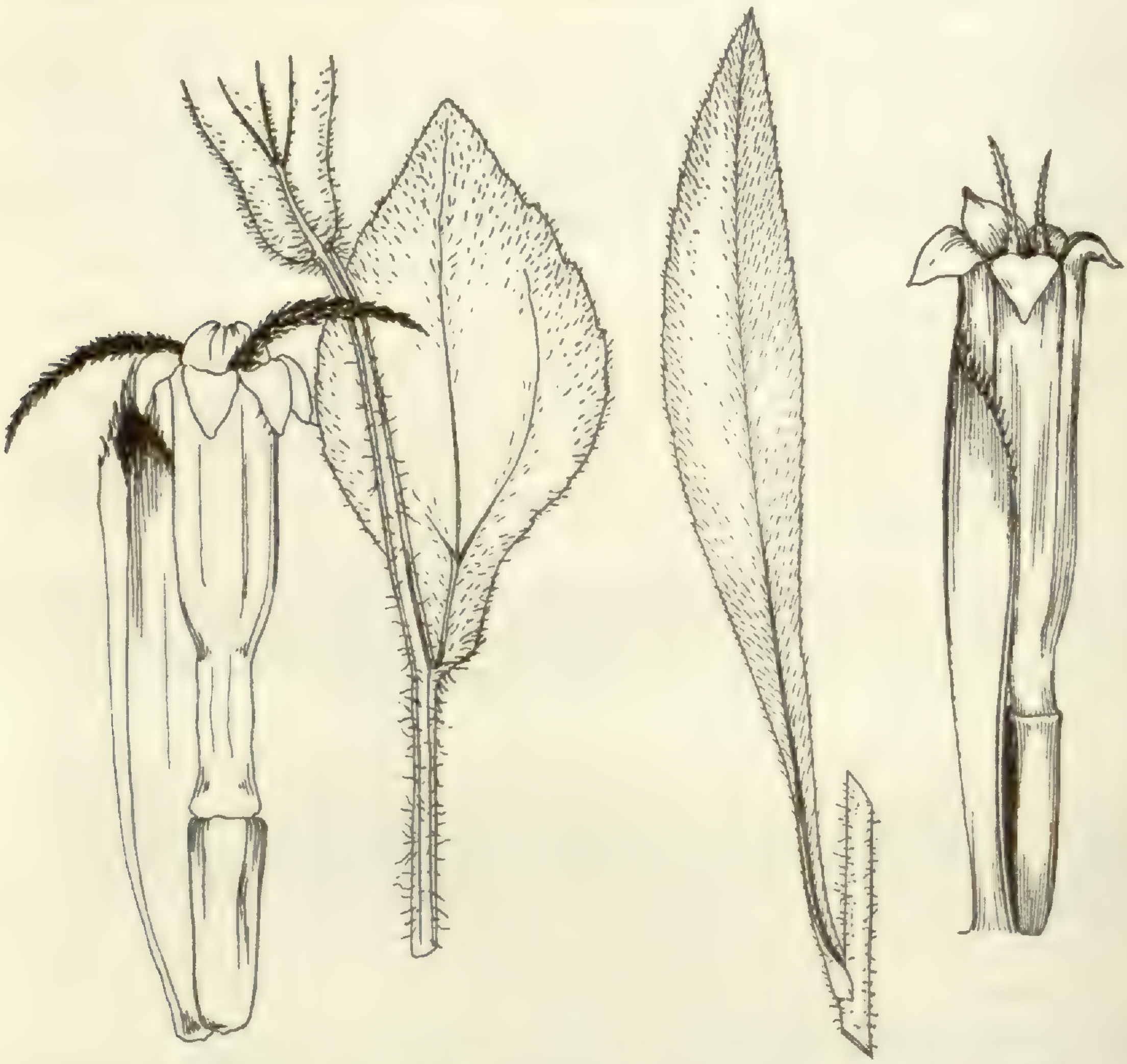
Two of the older references were to illustrations, but certainly Plukenet's figure is not of the same plant as that well illustrated and described by Dillenius, whose plate and description have been generally accepted as the standard, at least, of true *R. hirta*. Thus, in the Synoptical Flora, i². 260 (1884), Gray's first citation for *R. hirta* read: "Spec. ii. 907 (Dill. Elth. t. 218)".

Again, T. V. Moore in Pittonia, iv. 174 (1900) wrote: "The typical *R. hirta* can be identified easily, by reference to the figure and full description given by Dillenius, on which figure and description Linnaeus founded the species". The latter statement is, of course, somewhat overdrawn, since Linnaeus cited other descriptions and one other illustration and gave his own brief descriptive phrase. Furthermore, Linnaeus at that time had his own specimen (our FIGS. 1 and 2) which he clearly marked "Hort ups. [Hortus Upsaliensis] 3 *hirta*". This, of course, is the real TYPE of the species, although clearly conspecific with the Dillenian plant, both plants cultivated in Europe and derived from Virginia. This plant is native in open woods and thickets from western Massachusetts to Illinois, south to Georgia and Alabama and was described as *R. monticola* Small in Torreya, i. 67 (1901) or as *R. hirta*, var. *monticola* (Small) Fernald in RHODORA, xxxix. 457 (1937). The Linnaean type is clearly matched by many specimens, such as *Fernald & Long*, no. 8895 from rich woods south of Williamsburg, Virginia.

At first glance Linnaeus's type of *Rudbeckia hirta* suggests that he had a pied or parti-colored form such as is so frequent but rarely twice alike in the narrow-leaved plant which commonly though erroneously passes as *R. hirta* but which, originating in the Great Plains area of North America, has spread (long after the days of Linnaeus) as a field-weed generally eastward to Newfoundland and the Atlantic states. Close examination, however, shows that the dark areas, some of them not at the bases of ligules, are really crushed disk-florets which, owing to too much pressure on the disk, have assumed the false appearance of dark bases of golden ligules!

The common field-weed which has crossed the continent from the Great Plains, the plant with narrowly oblanceolate basal leaves and oblanceolate to lance-linear cauline leaves, which was erroneously treated and illustrated by the senior author as true *Rudbeckia hirta* in RHODORA, l. c. pl. 487, fig. 4 (1937), the weedy plant with somewhat bulbous-based trichomes, seems first to have been described as *R. serotina* by Nuttall in Journ. Acad. Nat. Sci. Phila. vii. 80 (1834), our PLATE 1102, FIGS. 3–5. Gray, in the Synoptical Flora, identified Nuttall's western plant, "at least the cult. plant described, fide herb. Acad. Philad."

with the wide-ranging plant he then called *R. hirta*, with the blanket-range, "Saskatchewan and W. Canada to Florida, Texas and Colorado: naturalized in grass-fields in Eastern States". This originally western narrow-leaved plant is also *R. flava* T. V. Moore, l. c. 179 (1900), an isotype from Wyoming well displaying



RUDBECKIA HIRTA (left) and R. SEROTINA (right): median cauline leaf, × 1; flower and pale, × ca. 10.

the characteristic bulbous-based trichomes. This now essentially transcontinental weed is, then, R. SEROTINA Nuttall.

Originating on the Great Plains or the foothills of the eastern Rocky Mountains, the plant obviously has had a wholly different history from the indigenous and broader-leaved plant of the eastern woodlands and thickets. Although the western species has now become thoroughly naturalized and is an aggressive

weed of fields, clearings and even borders of woodland near town, eastward to Newfoundland and the Atlantic coast of the United States, it differs from true *Rudbeckia hirta* in its consistently narrower leaves which are entire or only slightly crenate, whereas the lower and median leaves of *R. hirta* are broader and coarsely toothed (usually serrate); and the pales, disk-corollas and styles show striking differences, as brought out in the text-figures, p. 174, prepared for us by Mrs. Chester Cross (Shirley Gale). *R. serotina* seems better treated as a species than as a series of varieties of true *R. hirta*. Incidentally, genuine *R. hirta* has the conservatism of the old Appalachian forest-flora, while *R. serotina*, originating in a much more youthful campestrian region and with a strongly aggressive and pioneering habit, has shown a very great tendency to sport, especially in the form, size and color of its ligules, since it moved into the disturbed and cultivated areas to the east of its original home. In other words, in its newly adopted eastern area it is in a wholly unstable and aggressive stage of evolution, while true *R. hirta* is quite stabilized. The nomenclature of *R. serotina* and its principal variations is as follows:

Rudbeckia serotina Nutt. in Journ. Acad. Nat. Sci. Phila. vii. 80 (1834). *R. flava* T. V. Moore in Pittonia, iv. 179 (1900). *R. hirta* sensu Am. auth. in large part and especially Fernald in Rhodora, xxxix. 458 (1937).

Var. **lanceolata** (Bisch.) stat. nov. *R. lanceolata* Bisch., Del. Sem. Hort. Heidelb. 4 (1848); ex Walp. Ann. ii. 855 (1852).

Var. **sericea** (T. V. Moore), comb. nov. *R. sericea* T. V. Moore, l. c. 178 (1900). *R. hirta* L., var. *sericea* (T. V. Moore) Fern., l. c. 457, t. 487, fig. 3 (1937).

Var. **corymbifera** (Fern.), comb. nov. *R. hirta* L., var. *corymbifera* Fern. l. c. t. 487, figs. 1 and 2 (1937).

Among the innumerable sports of *Rudbeckia serotina* are the following:

Forma **tubuliformis** (Burnham), stat. nov. *R. hirta*, var. *tubuliformis* [as *tubuliforme*] Burnham in Am. Botanist, xx. 22 (1914).

Forma **rubra** (Clute), stat. nov. *R. hirta*, var. *rubra* Clute in Am. Botanist, xix. 134 (1913).

Forma **pulcherrima** (Farwell), stat. nov. *R. hirta*, var. *pulcherrima* Farwell in Mich. Acad. Sci. Rep. vi. 209 (1904).

Forma **annulata** (Clute), stat. nov. *R. hirta*, var. *annulata* Clute, l. c. (1913).

Forma **viridiflora** (Burnham), comb. nov. *R. hirta*, f. *viridiflora* Burnham, op. cit. xxii. 151 (1916).

Forma **homochroma** (Steyerm.), comb. nov. *R. hirta*, f. *homochroma* Steyerm. in Rhodora xl. 179 (1938).

Forma **pleniflora** (Moldenke), comb. nov. *R. hirta*, f. *pleniflora* Moldenke in Phytologia, ii. 320 (1947).

Many other forms doubtless occur. In this connection the statement from Clute is illuminating: "The original plant, with a blotch of red at the base of each ray-flower, is known as *Rudbeckia hirta pulcherrima.* Another form . . . is *R. h. rubra.* Still others . . . *R. h. annulata* . . . *R. h. tubuliforme* . . . and *R. h. flavescens* . . . The longer one works with *Rudbeckia hirta*, the clearer it becomes that the botanical species consists of a large number of elementary forms."—Clute in Am. Botanist, xxx. 159 (1924).

Chondrilla nudicaulis L. Mant. Alt. 278 (1771). This species is cited by Linnaeus as having its "*Habitat in* America *septentrionali; ad pyramides* aegypti". The plant is, as earlier recognized, *Lannaea nudicaulis* (L.) Hook. f. of Mediterranean regions and not known in America.

(To be continued)

STUDIES OF AMERICAN TYPES IN BRITISH HERBARIA

M. L. Fernald and Bernice G. Schubert

(*Continued from page 176*)

Part III. A Few of Philip Miller's Species

Pinus palustris Mill. Gard. Dict. ed. 8, no. 14 (1768).—Miller's description of *Pinus palustris* was very brief and rather inconclusive:

> 14. Pinus (*Palustris*) foliis ternis longissimis. *Pine-tree with the longest leaves growing by threes out of each sheath.* Pinus Americana palustris trifolia, foliis longissimis. Du Hamel. *Three-leaved, Marsh, American Pine with the longest leaves.*

Then, after discussing at length the propagation of pines, Miller continued:

> The fourteenth sort grows naturally on swamps in many parts of North America, where I have been informed they grow to the height of twenty-five or thirty feet. Their leaves are a foot or more in length, growing in tufts at the end of the branches, so have a singular appearance, but I have not heard the wood was of any use but for fuel; and there are few places here where these plants do well, for in very severe frosts their leading shoots are often killed, and in dry ground they will not thrive; so that unless the soil is adapted for them, it is to little purpose planting them.

Miller's *Pinus palustris* followed five other North American species, three of them with 3-leaved fascicles: *P. rigida* (leaves "3′–5′ long", *Sargent*, Man.); *P. Taeda* (leaves "6′–9′ long", *Sargent*) and *P. echinata* (leaves "3′–5′ long", *Sargent*) and

"longissimis" was evidently in comparison with these, unless borrowed from Du Hamel, although Miller's supplementary account of "leaves . . . a foot or more in length" was perhaps hearsay but must be taken into account.

Du Hamel, quoted by Miller, had simply

> 18. PINUS *Americana palustris trifolia, foliis longissimis.*
> PIN de marais à trois feuilles très-longues.[1]

Du Hamel had life-size plates of six species (not including his no. 18), these with leaves from 1–5 inches long. His "*longissimis*", then, meant more than 5 inches.

Although it is somewhat customary to treat as *Pinus palustris* Mill. the LONG-LEAF or GEORGIA PINE, Michaux filius, who surely knew our commoner trees, refused to take it up and named Long-leaf Pine *P. australis* Michx. f. Hist. Arb. Am. i. 64, pl. 6 (1810). It certainly is most doubtful if Miller (or Du Hamel before him) had *Pinus australis* growing in England or France. This tree is an inhabitant of sandy barrens or dry to dryish pine-barren or, extending locally back to the outer Piedmont, of dry crests or slopes of granitic or other siliceous rock: "C'est à peu de distance de Norfolk, dans la basse Virginie, où commencent les landes americanes, *Pine Barrens*, que le *Pinus australis* commence aussi à se montrer" (Michx. f., l. c. 65).

"The name originally imposed on this species is unfortunate, as it produces a false impression, and has been the source of error to foreigners, if not to our own countrymen. If an inhabitant of the Southern States, ignorant of Botany, should be interrogated respecting the P. Palustris or Swamp Pine, he would instantly revert to the P. Taeda, and his answers would be drawn from that species.

"Grows in dry sandy soils, where the sub-soil however, though 2 or 3 feet below the surface is usually of clay, covering nearly all of the ridges along the coast of Carolina and Georgia within 120 miles of the ocean. Wherever the land becomes moist or fertile, the P. Taeda, and sometimes the P. Rigida encroach upon it."—Elliott, Sk. ii. 637, 638 (1824).

"Occupying all the highest and driest sandy lands" of eastern North Carolina (Pinchot & Ashe, Timber Trees and Forests of North Carolina, 131 (1897)); etc., etc.

Everyone who knows the Long-leaf Pine in its native soil will agree with F. A. Michaux and Elliott that the specific epithet *palustris* as applied to it is wholly misleading. They will also

[1] Du Hamel, Traité des Arbres, ii 126 (1755).

agree that there are 3-leaved pines in the South which delight in savannas, marshes or wet shores: such characteristic trees as Loblolly or Swamp Pine, *P. Taeda* L., its tendency (although often enough in old fields and dry soils) to grow in swamps noted (above) by Elliott and emphasized by Pinchot & Ashe (p. 125) when they wrote: "The original growth is on moist deep soil, but the second growth has sprung up largely in old fields", etc., whence the common name Old-field Pine. In other words, *P. Taeda*, one of the most aggressive and weedy pines of the South, will grow in either dry or wet habitats and many labels before us bear such data as the following: "peaty pineland", "light, moist soil"; "light, mostly damp soil"; "old fields (also in swamps)"; "moist or wet woods". Another 3-leaved pine of wet or marshy habitats is Pond Pine, Savanna Pine or Swamp Pine, *P. serotina* Michx., Fl. Bor.-Am. ii. 205 (1803), described by the elder Michaux as growing "in humidis . . . cupressetis"; habitats restated in Elliott's "Grows around ponds and in damp soils"; and well stated by Pinchot & Ashe's "It occurs on low peaty or wet sandy soils of the worst quality". A third southern pine which often has three leaves and to which Small applies the name *P. palustris*, is the very southern Slash or Swamp Pine, which was first recognized by Elliott as *P. Taeda*, var. *heterophylla* Ell., Sk. ii. 636, growing "Along the marshes near the mouths of the fresh-water rivers (at least in Georgia)". This was renamed *P. Elliottii* Engelm. in Sargent, Cat. Forest Trees, 74 (1880) and in Trans. Acad. Sci. St. Louis, iv. 186, t. 1–3 (1880). In his Report on Forests N. Am. 202 (1884) Sargent reduced this species to *P. cubensis* Griseb., a West Indian species which, passing up the Florida Keys to peninsular Florida, reaches its northern limit in marshes of southeastern South Carolina. To be sure, Small maintains the West Indian tree which reaches the Keys as distinct from *P. Elliottii*, to which he applies the name *P. palustris*. The separation of the two seems rather doubtful but, even so, *P. Elliottii* (Small's *P. palustris*) is assigned by Small to "Shallow ponds, swamps and low grounds . . . thriving under the influence of either salt or fresh water." Sargent's statement in the Silva, xi. 158, is very different: calling it *P. heterophylla* (Ell.) Sudworth, Sargent said: "mingled with the Long-leaved and Loblolly Pines in the open forests . . . As a timber-tree the

Slash Pine, which produces straight sound spars of large dimensions, is little inferior to the Long-leaved Pine, the wood of the two trees being usually manufactured and sold indiscriminately. It is heavy, exceedingly hard, very strong, tough, durable.....” That is not a very good match for Miller's “I have not heard the wood was of any use but for fuel; . . . and in dry ground they will not thrive”. Here, then, are species for which the name *P. palustris* or “Marsh Pine” of Miller or “Pin de marais” of Du Hamel would be perfectly appropriate; for surely these names, as F. A. Michaux and Elliott clearly stated, are not appropriate for Long-leaf Pine.

As emphasized, Miller, who, as shown by his second paragraph, was quoting vaguely what “I have been informed” by those who had seen trees “growing naturally on swamps in many parts of North America”, had “not heard the wood was of any use but for fuel”. Surely such a characterization of the wood is not applicable to that of Long-leaf Pine, “The most valuable of the Pitch Pines and one of the most important timber-trees of North America, . . . produces heavy, exceedingly hard very strong tough coarse-grained durable wood” (Sargent, Silva, xi. 153 (1897)); nor is it applicable to *P. Elliottii*, *heterophylla* or *cubensis*, as noted above. But *P. Taeda*, “introduced into Europe before 1713” (*Sargent*, l. c. 114), has long been called Loblolly Pine, from *loblolly*, a loutish, foolish or useless person, and, although, when grown on dry upland now an important wood in eastern Virginia, it has the timber thus described by Sargent (l. c. 113): “A large part of the trees of original growth and the oldest and best matured second-growth trees now produce coarse-grained wood, nearly one half the diameter of the trunk being sapwood, while the wood of trees which have grown rapidly on abandoned fields and now supply an important part of the timber cut on the south Atlantic coast, whence it is shipped in large quantities to the north, is very coarse-grained and still more largely composed of sapwood.” F. A. Michaux wrote (p. 99):

“J'ai toujours vu avec surprise que des arbres de 7 décimètres (30 pouces) de diamètre, à 1 mètre (3 pieds) de terre, avoient 5 à 6 décimètres (20 à 24 pouces) d'aubier, et je n'ai jamais trouvé dans des individus d'environ 3 décimètres (un pied) de grosseur, et de 10 à 11 mètres (30 à 35 pieds) de haut, plus de 3 centimètres (un pouce) de

coeur ou de vrai bois: aussi les couches concentriques sont-elles extrêmement espacées dans ce Pin, et c'est ce qui explique la grande rapidité avec laquelle il croît, surtout dans les Etats méridionaux, où j'ai le plus souvent fait cette observation. En Virginie où il vient dans des terreins plus secs, et par conséquent moins rapidement, il n'a pas autant d'aubier, et son bois est d'une contexture plus compacte."

Elliott (p. 636) summarized his account: "but the heart or real wood is much smaller in proportion to its diameter, and even in its best state it is very inferior". So, even though upland (rather than marsh or lowland) stands of *P. Taeda*, especially in Virginia, are now sources of valued timber, the original swamp-grown trees could well have merited Miller's "I have not heard the wood was of any use but for fuel".

While she was in England the junior author was not able to get at any of Miller's material of *Pinus palustris*. However, Dr. George Taylor has obligingly hunted for this material and, though he found no indication that there ever was an actual type of Miller's, he writes: "At Tring. . . . I . . . found an old specimen from Dr. Collinson's Garden at Millhill which it is just possible Miller saw. The sheet is inscribed on the back 'Hort. Drs' Collinson ad Millhill'. The sheet is written up 'Pinus palustris Swamp Pine' in an old hand which, unfortunately, is now hardly legible. I have compared the writing with that of Philip Miller and, though there are certain minor discrepancies, it is possible that he may have put the identification on the sheet. I have mounted two spur shoots from this specimen and send them herewith."

These fascicles and their sheaths, 8 to 8½ inches long (not "a foot or more in length", as stated by Miller), are readily matched by those of *Pinus Taeda* but not by those of the Long-leaf Pine; they could be from Pond Pine, *P. serotina* Michx., but not so well from *P. cubensis*. That the only possibly authentic material of *P. palustris*, bearing that name in a hand only doubtfully Miller's, was from a cultivated specimen of *P. Taeda* L. seems fairly apparent, that species in its primitive habitat (before it became Old-field Pine) well justifying the name *P. palustris*. It is not without significance that Bean, in his remarkably detailed Trees and Shrubs Hardy in the British Isles, ii. 170 (1914), should have very definitely excluded from consideration some species "because their garden value is *nil*".

These include "P. PALUSTRIS *Miller* (P. australis, *Michaux*) . . . too tender to succeed well in our climate" and *P. Taeda* which "can only be grown in the mildest parts of our islands". If Miller's very mixed and indefinite account, based largely on hearsay, stood for a definite species it probably did not include Long-leaf Pine, "too tender to succeed well", and there is no evidence (at least in Bean's synopsis) that the more southern and largely tropical *P. cubensis* was ever grown in England. It seems right, therefore, to follow F. A. Michaux, Loudon, Spach, Endlicher, Lindley & Gordon, Dietrich, Chapman, M. A. Curtis, Parlatore, Engelmann, Small and others in calling Long-leaf Pine PINUS AUSTRALIS Michx. f. That name is absolutely definite; *P. palustris* hopelessly indefinite.[1]

CLEMATIS CANADENSIS Mill. Gard. Dict. ed. 8, no. 5 (1768) is represented by characteristic foliage-material and a flowering spray of *C. virginiana* L. (1753). Miller stated that "the seeds do not ripen in England, unless the season is very warm. There is little beauty in this sort." The fact that his material was staminate may account for the "little beauty" of his plant.

FRAXINUS CAROLINIANA Mill. Dict. ed. 8, no. 6 (1768) was rather vaguely described by Miller:

> 6. FRAXINUS (*Caroliniana*) integerrimis petiolis terretibus fructu latiore. Prod. Leyd. *533*. *Ash-tree with entire leaves and taper foot-stalks*. Fraxinus Caroliniana, latiore fructu. Rand. Cat. H. Chels. *Carolina Ash with a broad fruit.*

Miller also stated:

> The sixth sort was raised from seeds which were sent from Carolina in the year 1724, by Mr. Catesby. The leaves of this sort hath seldom more than three pair of lobes, the lower being the least, and the upper the largest; these are about five inches long and two broad, of a light green colour, and slightly sawed on their edges; the foot-stalk, or rather the midrib, of the leaves is taper, and has short downy hairs; the seeds are broader than those of the common Ash, and are of a very light colour. As this sort hath not yet produced seeds in England, it is propagated by grafting it upon the common Ash.

Florae Leydensis Prodromus by Royen (1740), cited by Miller, has simply the two citations later given by Linnaeus for his mixed *F. americana* (see p. 168). In other words, the latter references were to two quite different species, since the Gronovian account was based upon a specimen of conventional *F. americana*

[1] Since this discussion went into type Dr. E. L. Little, in Phytologia, ii. 457, 458, July, 1948, has urged the retention of the name *Pinus palustris* in place of *P. australis*.

L. (1753), while the Catesby plate is of the species generally interpreted as *F. caroliniana.*

In the herbarium of the British Museum of Natural History there is a sheet which has sometimes been taken to be the type of *F. caroliniana* (our neg. 110) and which reflects the confusion which has prevailed from the first; for this specimen, bearing the identification, apparently in Miller's hand, *F. caroliniana,* is a characteristic fruiting branch of *F. pennsylvanica* Marsh. In view of Miller's statement that his *F. caroliniana* had not fruited in England this specimen with abundant fruit can hardly be taken as the type of Miller's species! Incidentally, Miller's emphasis on the broad fruit is certainly not applicable to the unusually slender-based and narrow samaras of *F. pennsylvanica.* Furthermore, when Lamarck described his *F. pubescens* Lam. Encycl. ii. 548 (1786) he gave a detailed description of the flowers, *F. pubescens* being identical with *F. pennsylvanica.* Even though an authentic specimen of Miller's species may yet be found, the facts, that the seeds were sent by Catesby and the fruit described as broad, are fair justification for the general interpretation of Miller's species, which for want of a known type is exemplified in the Catesby plate.

The inclusive *F. caroliniana* of the southern Coastal Plain and Cuba is extremely variable, especially in outline of leaflets, degree of pubescence and shape of samara, and upon these characters many species and varieties have been proposed. A study of the assembled material in the Gray Herbarium and that of the Arnold Arboretum indicates that the species may appropriately be treated as consisting of its primary element and two fairly marked geographical varieties, but that otherwise the minor variations, such as three-winged fruits and fluctuating pubescence, are not of such strong character. In all three varieties glabrous and pubescent foliage occur and in the commonest and typical variety the fruits may be flat and two-winged, concave and spoon-shaped or definitely three-winged. In regard to this point the late M. A. Curtis, who certainly knew the trees of North Carolina, wrote when defining his two varieties of *Fraxinus platicarpa* Michx. (which is identical with *F. caroliniana*): "These varieties, like the more common form, frequently have the samaras three winged". In the material with three-winged

samaras two-winged fruits often occur in the same inflorescence, while on those which bear concave and spoon-shaped fruits flat samaras are often found. These variations are in the nature of sports rather than true varieties or forms.

Briefly summarized the three seemingly significant varieties are:

F. CAROLINIANA (typical).—Petioles and rachis glabrous; lower leaflet-surface glabrous or only sparsely pilose along nerves; fruit broadly oblong-oblanceolate to rhombic or sub-elliptic, either obtuse or acutish, 1–2 cm. broad, 2.5–4.5 cm. long.—Swamps, low woods and pond-margins, Florida to eastern Texas, north on Coastal Plain to southeastern Virginia and Arkansas.—*F. caroliniana* Miller, Gard. Dict., ed. 8, no. 6 (1768). *F. americana* sensu Marsh. Arbust. Am. 50 (1785), not L. (1753). *F. excelsior* sensu Walt. Fl. Carol. 254 (1788), not L. (1753). *F. platicarpa* Michx., Fl. Bor.-Am. ii. 256 (1803); Michx. f. Hist. Arb. Am. iii. 128, t. xiii (1813). *F. triptera* Nutt. Gen. ii. 232 (1818) and Am. Sylva, iii. 62, t. C [large fruit at left] (1849). *Samarpses triptera* (Nutt.) Raf. New Flora, iii. 93 (1838). *Fraxinus americana* L., var. *caroliniana* (Mill.) D. J. Browne, Trees of Am. 398 (1846). *F. americana*, var. *triptera* (Nutt.) D. J. Browne, l. c. 399. *F. nigra* Marsh., subsp. *caroliniana* (Mill.) Wesmael in Bull. Soc. Bot. Belg. xxxi. 113 (1892). *F. caroliniana* Mill., var. *platicarpa* (Michx.) Lingelsh. in Engl., Bot. Jahrb. xl. 221 (1907).

Forma **pubescens** (M. A. Curtis), stat. nov.—Petioles, rachis and lower surface of leaflets tomentose.—Occasional with the tree with glabrous leaflets.—*F. platicarpa* Michx., β. *pubescens* M. A. Curtis in Am. Journ. Sci. ser. 2, vii. 408 (1849), ISOTYPE in Gray Herb. *F. Rehderiana* Lingelsh. in Engl., Pflanzenr. iv^{243}. 42 (1920), ISOTYPE in Herb. Arn. Arb. *F. caroliniana* Mill., var. *Rehderiana* (Lingelsh.) Sarg. in Journ. Arn. Arb. ii. 173 (1921). *F. caroliniana* Mill., var. *pubescens* (M. A. Curtis) Fern. in RHODORA, XXXIX. 442 (1937).

Var. **oblanceolata** (M. A. Curtis), comb. nov.—Foliage glabrous or essentially so; samaras oblanceolate, either obtuse or acute, 1–1.3 cm. broad, 3.5–5.5 cm. long.—Less common, Florida to southeastern Virginia.—*F. platicarpa* Michx., γ. *oblanceolata* M. A. Curtis in Am. Journ. Sci. ser. 2, vii. 408 (1849), ISOTYPE in Gray Herb. *F. pauciflora* Nutt. Am. Sylva, iii. 61, t. C [excl. 3-winged samara] (1849). *F. platicarpa* Michx., var. *floridana* Wenzig in Engl., Bot. Jahrb. iv. 185 (1883), ISOTYPE in Herb. Arn. Arb. *F. Nuttallii* Buckley in Proc. Phil. Acad. 444 (1860). *F. hybrida* Lingelsh. in Engl., Bot. Jahrb. xl. 220 (1907), portion of TYPE in Herb. Arn. Arb.

Curtis's description of his *F. platicarpa*, γ. *oblanceolata* read

"Glabrous. Samaras oblanceolate" and he stated that he had received it from the region of Santee Canal, sent by Ravenel. Such a sheet from Santee Canal is in Ravenel's herbarium at Converse College and a fragment from it is in the Gray Herbarium. Its fruit is like that illustrated by Nuttall for his *F. pauciflora* and by Lingelsheim for his *F. hybrida.*

The following are characteristic northern specimens: VIRGINIA: swamp bordering West Neck Creek, west of Pungo, Princess Anne County, *Randolph & Randolph*, no. 500; siliceous and argillaecous alluvium bordering cypress-swamp, bottomland of Nottoway River, above Cypress Bridge, Southampton County, *Fernald & Long*, no. 6335; wooded bottomland on Fontaine Creek southeast of Taylor's Millpond, Greensville County, *Fernald & Long*, no. 10,391.

Var. OBLANCEOLATA, forma **hypomalaca,** f. nov., foliolis subtus tomentosis.—Local.—The following specimens have been examined: VIRGINIA: cypress-swamp, wooded bottomland, Fontaine Creek, southwest of Haley's Bridge, Greensville County, June 9, 1946, *Fernald & Moore*, no. 15,139 (TYPE in Herb. Gray.; ISOTYPE in Herb. Phil. Acad.). SOUTH CAROLINA: Santee River-swamp, *H. W. Ravenel.* LOUISIANA: without further locality, *Hale* (fruit 3-winged).

Var. CUBENSIS (Griseb.) Lingelsh.—Leaflets glabrous or sparsely pilose beneath; samaras narrowly oblanceolate, 5–9 mm. broad, 3–5 cm. long.—Cuba and Florida and presumably farther north.—*F. cubensis* Griseb. Cat. Pl. Cub. 170 (1866). *F. caroliniana* Mill., var. β. *cubensis* (Griseb.) Lingelsh. in Engl., Bot. Jahrb. xl. 221 (1907). *F. viridis* Michx., var. *Berlandierana* sensu Wright et Sauvalle, Fl. Cub. 88 (1873), not var. *Berlandieriana* Torr. (1859).

Although Grisebach originally cited no number, Wright and Sauvalle, citing *Fraxinus cubensis* as a synonym of *F. viridis*, var. *Berlandierana*, gave only one number, *Wright*, no. 3624. The specimen of this number in the Gray Herbarium has leaflets pilose on the nerves beneath, while all other material from Cuba and from Florida has quite glabrous leaflets.

Var. CUBENSIS, forma **lasiophylla,** f. nov., ramulis petiolis rhachibus et paginis inferioribus foliolorum dense tomentosis.—VIRGINIA: upper border of sandy and peaty shore of Darden's Pond, north of Courtland, Southampton County, September 15 and 16, 1946, *Fernald, Long & Clement*, no. 15,335 (TYPE in Herb. Gray.; ISOTYPE in Herb. Phil. Acad.).

At Darden's Pond var. *cubensis*, forma *lasiophylla* is far re-

moved geographically from typical glabrous or subglabrous var. *cubensis* which, in the two herbaria studied, is represented only from Cuba and very slightly from Florida. The weakness of these herbaria in material from the Coastal Plain of Georgia and the Carolinas may account for its seeming absence from the intermediate broad belt. Forma *lasiophylla* differs from typical var. *cubensis* only in the dense pubescence, a character which in the two commoner varieties seems only formal.

Prunella caroliniana Mill. Gard. Dict. ed. 8, no. 6 (1768), described "foliis lanceolatis integerrimis . . . petiolatis" etc., is represented by a characteristic specimen of *P. vulgaris* L., var. *lanceolata* (Barton) Fernald in Rhodora, xv. 183 (1913). Hultén treats this plant as a subspecies; should it be treated as a species, Miller's binomial would be the proper name. P. nova-anglia Mill. l. c., no. 7, is characteristic introduced *P. vulgaris* L. His P. canadensis, l. c. no. 4, is surely not a *Prunella*. The photograph of a very distinctive species which accords with Miller's description of a plant which "grows naturally in North America" has yet to be matched.

Eupatorium ramosum Miller, Gard. Dict. ed. 8, no. 13 (1768), which "grows naturally in Maryland", is represented by a very characteristic specimen of *E. altissimum* L. Sp. Pl. ii. 837 (1753). Since Gray (Syn. Fl.) does not mention Miller's species and Index Kewensis maintains it as a kept-up species, its identity seems not previously to have been established. The photograph shows, not only the habit and inflorescence, but the obtuse linear-oblong phyllaries of *E. altissimum*.

Helianthus ramosissimus Mill. Gard. Dict. ed. 8, no. 8 (1768) is represented by a freely branched specimen of *H.* dec*apetalus* L. (1753). Miller's "foliis lanceolatis" for this and for his no. 7, H. trachelifolius would have been more descriptive of his types if changed to lanceolato-ovatis.

Part IV. Some Species of Thomas Walter
(Plates 1103–1115)

Thomas Walter's own herbarium, on which he based his Flora Caroliniana (1788), was early destroyed, but he had given fragments of many of his plants to his publisher, John Fraser (1750–1811) of London, these, so far as known, being essentially

all that exist to show what Walter was describing. John Fraser, senior, passed the collection on to his son and namesake (1799–1860?), who, on May 23, 1849, presented it to the Linnean Society of London, where, as not the work of Linnaeus, it was treated as a "Surplus Collection" (fortunately not as mere rubbish) and sold to the British Museum of Natural History in 1863 for the sum of 15 shillings. This collection, constituting a folio volume of 117 pages, each page with several scraps pasted on, is now carefully safeguarded at South Kensington. According to the detailed account of it by the late James Britten[1] it was studied by only a few American botanists before it reached the British Museum: by Pursh and by Gray but few, if any, others. Numerous recent students have studied Walter's plants and in 1915 Blake discussed in detail several of his species, in Rhodora, xvii. 129–137; the senior author and Mr. Bayard Long studied them in 1930 and the junior author in the winter of 1946–47 made detailed studies of many heretofore unconsidered specimens and photographed the whole series, her results now in a very plump volume on the shelves of the Gray Herbarium. Blake and, after him, Britten have commented on the absence of some of Walter's species from the Fraser volume and the very confused and often quite misleading names which are attached to many specimens; and Britten pointed out that the small specimens and their labels, too often in the hand of one of the Frasers, rather than of Walter, had obviously been cut from their earlier place of mounting and had been remounted in alphabetical order, according to the often wholly erroneous identifications which the mounter (presumably one of the Frasers) had seen fit to place with them. Thus perfectly obvious *Oxalis* is called *Pinguicula* and characteristic *Pinguicula* is called *Utricularia*. On the other hand, a large proportion of the labels are correctly placed, such distinctive species as *Arethusa racemosa* (*Ponthieva*), *A. divaricata* (*Cleistes*), *Cypripedium reginae* or *Eupatorium fusco-rubrum* being properly labeled. As others have pointed out, however, the labels, as they now stand, must be partly ignored and the effort directed to matching the fragments with Walter's descriptions. This we have done in some

[1] See James Britten in Journ. Bot. lix. 69–74 (1921). For an enumeration of articles regarding Walter and his collections see Maxon in Smithsonian Misc. Coll. xcv. no. 8 (1936).

cases and the results are presented in the following pages and plates; many others, not yet worked out, must await future study.

The earliest very critical study of this Fraser series of Walter's plants was, evidently, that of Frederick Pursh; the next by Asa Gray, on his first European trip, in 1839. Gray, most fortunately, left a note-book containing his identifications, although he was inclined to doubt the value of the collection on account of the confusion of labels. To what extent the Fraser series had been tampered with, aside from the remounting and the misidentifications, we can not say, but some of the authentic specimens were surely removed. Thus Gray in 1839, made memoranda which, though already published, may be here repeated, the first from Rhodora, xli. 537, footnote (1939). "Gray noted under *Clematis holosericea*, which Pursh described from '*Herb. Walter*': 'There is nothing in Walter's herb. to correspond to this . . . Pursh must have carried off the specimen, or part of it'. Then follows in another ink: 'P. S. He has taken it all to herb. Lambert—which see'. Pursh and his patron, Lambert, were not the only early botanists who felt that Walter's plants would be of better service elsewhere (for instance, see note on *Lobelia glandulosa* by Fernald & Griscom, Rhodora, xxxix. 497)". The latter note was as follows, this after the statement that nothing could be found in 1937 in Walter's herbarium to match his description of *L. glandulosa*. "However, in the Gray Herbarium there is a full raceme of such a plant, with definitely dentate calyx-lobes, which was labeled by Asa Gray as follows; '*Lobelia* Walt. *L. glandulosa* fl.! Cf. no. 2 in notes.' This specimen is in a pocket labeled in Gray's hand: 'Herb. Walter! See notes.'

"The pertinent facts are as follows. Asa Gray examined the Walter Herbarium in February, 1839, and left a small book of notes upon it. Under *Lobelia glandulosa* there is the following comment: 'I take fl. fr. specimen verum, but the cal. segments are entire. A loose spec. without specific name—a smooth plant—agrees better with descr [iption] as to calyx (no. 2).' It becomes apparent, therefore, that the only element which Walter had with '*calycis laciniis dentatis*' was given to Asa Gray. In view of the fact that this is the only extant type of the Walter

plant with dentate calyx-lobes, the plant definitely accepted by Elliott, Gray and McVaugh as *L. glandulosa*, the name should stand for this element. A portion of the inflorescence has been returned to the British Museum." If anything is now removed from the Fraser volume we shall know about it; we have a complete photographic reproduction of all the pages.

MELANTHIUM HYBRIDUM Walt. Fl. Carol. 125 (1788), is often cited with a mark of interrogation as probably synonymous with *M. latifolium* Desr. in Lam. Encycl. iv. 25 (1796), the latter collected in Virginia by Fraser and described with "Les pétales . . . unguiculés, à onglets presqu'aussi longs que les lames. Celles-ci ont une forme pour ainsi dire orbiculaire, & paroissent légèrement ondulées sur les bords." A photograph of Desrousseaux's TYPE before us shows it to be correctly understood. We feel, however, that Walter's earlier name was given to the same species. Walter divided *Melanthium* into two series, the first with "Petalis unguiculatis imprimis albis demum obscuro-rubris seminibus *semi ovatis*", the second "Petalis sessilibus, seminibus *ovatis*", the second series containing plants now referred to *Amianthium*, *Tofieldia*, etc. Walter's *M. hybridum*, with unguiculate petals and semi-ovate seed, was further described "petalis plicato-undulatis mmaculatis [evident misprint], floribus masculis et foemineis mixtis". One has only to look at representative specimens of *M. latifolium* and at the illustration (fig. 982 in ed. 1, fig. 1236 in ed. 2) in Britton & Brown in order to see a depiction of the "petalis plicato-undulatis" and an inflorescence "floribus masculis et foemineis mixtis". The species occurs in both the Carolinas and the detailed illustrations in Small's Manual show nothing else in the South which could have been meant by Walter. We are taking up M. HYBRIDUM Walter. It was recognized by Elliott, who gave a detailed description of a specimen received from Georgia, with "sterile and fertile flowers intermingled in each panicle. *Petals* persistent, orbicular, plaited, the margins waved or repand."

PANCRATIUM CAROLINIANUM Walt. Fl. Carol. 120 (1788), is represented by an unusually well prepared inflorescence, showing the very large crown with stamens borne at the summits of the broad lobes exactly as in the Carolinian and Georgian *P. coronarium* LeConte in Ann. Lyc. N. Y. iii. 145, t. 4, figs. 7–9 (1830),

which "Inhabits in Savannah river, at the rapids, a few miles above Augusta, where it covers the rocky islets. I have also seen it in the Congaree river, at Columbia, in South Carolina, occupying similar situations." Marc Catesby had a beautiful plate of the plant, the large crown and other characters as shown in the Walter specimen and in LeConte's figures, Catesby calling it *Lilio-Narcissus Polianthus, flore albo*, Catesby Carol. ii. Append. 5 (1754), he saying "These Plants I saw growing in a bog near *Palluchucula*, an *Indian* town on the *Savanna* river, within the precinct of *Georgia*." The Catesby account and plate became the basis of *Hymenocallis caroliniana* Herbert, Append. 44 (1821), Herbert making no reference to Walter. *H. caroliniana* Herbert, was, then, identical with and found in the same region as Walter's *Pancratium carolinianum* but not based upon it. The later *Hymenocallis coronaria* (LeConte) Kunth (1850) should, therefore, be called

HYMENOCALLIS CAROLINIANA Herbert, Append. (to Bot. Reg. vii), 44 (1821). *Pancratium carolinianum* Walt. Fl. Carol. 120 (1788). *P. coronarium* Le Conte in Ann. Lyc. N. Y. iii. 145, t. 4, figs. 7–9 (1830). *H. coronaria* Kunth, Enum. v. 855 (1850).

Index Kewensis does not clarify the situation by referring *Hymenocallis caroliniana* Herb. to the quite different Mediterranean *Pancratium maritimum* L., while *H. coronaria*, identical with and from the same region as *H. caroliniana*, is referred to the smaller-crowned *H. crassifolia* Herbert. It is evident that the names in the genus need clarification.

ASARUM CAROLINIANUM Walt. Fl. Carol. 143 (1788) is represented by no specimen but the description clearly indicates, as has been thought, some form of *A. canadense* L. (1753). A. VIRGINICUM sensu Walt., not L. (1753) is represented by a characteristic leaf of *A. arifolium* Michx. (1803) and it agrees with Walter's description.

POLYCARPON UNIFLORUM Walt. Fl. Carol. 83 (1788). The very clear description of this plant, with "foliis succulentis ellipticis humisparsis, pedunculis lateralibus unifloris", is so like that of Michaux's *Spergulastrum lanuginosum*, the basis of *Arenaria lanuginosa* (Michx.) Rohrb., that it seems wholly probable that the suggested identification of the two as one species by Robinson in Gray, Syn. Fl. i[1]. 240 (1897) was quite justified. Since the

name *Arenaria uniflora* is preempted no transfer of Walter's name to *Arenaria* is called for.

STELLARIA UNIFLORA Walt. Fl. Carol. 141 (1788), our PLATE 1103, FIGS. 1 and 2, has evidently been misinterpreted by Robinson in Gray, Syn. Fl. N. Am. i[1]. 237 (1897) and by later as well as some earlier authors. Robinson's description reads:

> "weak and slender: stems decumbent or suberect, a foot in length: leaves linear, acute, or the lower lanceolate, gradually narrowed below, mucronate, 8 to 12 lines [1.7–2.5 cm.] in length; the floral much reduced: flowers few, solitary, on elongated slender peduncles: calyx soft in texture, sepals scarcely veined", this species coming under a section with "Petals retuse or shortly bifid, divided only one fourth to one half the way to the base", etc.

Small, calling the plant of Robinson's treatment *Sabulina uniflora* (Walt.) Small, gives (Man. 498) the following description:

> "Stems 1–3 dm. tall: leaf-blades linear, 1–4 cm. long, acute: pedicels 2–8 cm. long: sepals lanceolate, 4–5 mm. long, acute: petals linear-cuneate, 6–8 mm. long: seed 0.5 mm. long, minutely roughened. [*Stellaria uniflora* Walt.]—Meadows or springy places, Coastal Plain and adj. provinces, Fla. to Ala. and N. C.—Spr."

There is no question about what plant Robinson and, after him, Small intended by *Stellaria uniflora* or *Sabulina uniflora*, a paludal species illustrated in our PLATE 1104; but that it is what Walter had before him and described is very seriously doubted. Walter, calling his species a *Stellaria* because of the emarginate petals, his *Arenaria* having "Petala 5 integra" (Walter having the characters, as now understood, reversed), gave a description which is scarcely applicable to the plant of Robinson and of Small, for the latter weak and paludal species has dilated and fleshy leaves, glabrous calyx and rather deeply notched petals. Here was Walter's account:

> *uniflora* 1. foliis subulatis oppositis; pedunculis alternis unifloris foliis triplo longioribus; calycibus subhirsutis (non striatis) petalis calyce longioribus, albis, emarginatis; capsulis ovatis.

Such a description, emphasizing the *subulate* leaves, subhirsute calyx and merely emarginate petals, certainly would be misapplied to the plant generally called *Stellaria* or *Sabulina uniflora* but, most fortunately, Fraser had a good specimen (our PLATE 1103, FIGS. 1 and 2) of a plant marked by him "No Name"

(on p. 100) which to us seems to be what Walter described. This has subulate leaves, and specimens (FIG. 3) which closely match it have the plane sepals somewhat glandular-hispidulous ("calycibus subhirsutis (non striatis)"). Asa Gray, examining this page, made the memorandum in his notes that the specimen marked "No Name" looked like *Arenaria brevifolia* Nutt. The Walter diagnosis and the specimen which it matches are certainly of the latter species, as Gray indicated. Small's figures on page 499 of his Manual, illustrating *Sabulina*, were evidently made from *S. brevifolia* (Nutt.) Small, they showing the details of flower and fruit of *A. brevifolia:* the white-margined blunt sepals with hispidulous back, the emarginate petals and the ovoid capsule slightly exceeding the calyx[1] ("calycibus subhirsutis (non striatis) petalis calyce longioribus, albis, emarginatis; capsulis ovatis".—Walter).

From Index Kewensis one would assume that the name *Arenaria uniflora* was used for a species by Poiret, Encycl. vi. 375 (1804), but Poiret was not describing a species but a minor variation of *A. recurva* Allioni as "β. *Arenaria* (uniflora)", this plant treated by such authors as Schinz & Thellung or Ascherson & Graebner as a trivial variation, with no binomial cited in their bibliography.

There is, however, an earlier *Arenaria uniflora* which was properly described as a new species, so that Walter's *Stellaria uniflora* cannot be transferred to *Arenaria.* The name in question is *Arenaria uniflora* Luce, Topogr. Nachr. Oesel, 141 (1823). This volume by Luce or Lucé seems to be very rare and its contents often unknown even to botanists of the Baltic area. Thus, Fenzl in Ledebour, Fl. Ross. ii. 167 (1843) cites with doubt "Arenaria uniflora. LUCÉ *Fl. osil.?*", while some other writers on the region, even in modern works on the flora of Oesel, do not mention the author or his species. The name of the author, likewise, seems to vary. On the title-page of the *Topographische Nachrichten von der Insel Oesel* he appears as "*Dr. Joh. Wilh. Ludw. v. Luce*". On the secondary title-page, *Prodromus Florae osiliensis*, his name is similarly given, and the long Vorrede

[1] Although Small's artist well displayed the entire blunt sepals and the emarginate petals, the author or printer of Small's description got badly tangled, the text reading "sepals . . . truncate or emarginate: petals spatulate or obovate: spatulate, 4–5 mm. long".

is signed Dr. *v. Luce.* Pritzel, however, lists him as Lucé and such of his binomials as were caught in Index Kewensis are ascribed to Lucé.

The Prodromus is very rarely represented in American libraries. For an opportunity to examine a copy we are indebted to the courtesy of the Librarian of the University of Chicago.

As to the plant treated by Torrey & Gray and by Robinson as *Stellaria uniflora* and by Small as *Sabulina uniflora*, some earlier authors were much confused. Thus, Elliott, Sk. i. 520 (1821), described as *A. glabra* Michx. (which Small assigns to "Cliffs, Blue Ridge and Appalachian Plateau") a plant which "Grows in the swamps of the Santee river, from Murray's to Nelson's Ferry. Dr. Macbride", and cited *Stellaria uniflora* Walt. as an unquestioned synonym. The plant of swamps of the Santee River, as shown by characteristic material collected by Ravenel as "*Arenaria glabra*" but marked by Gray as *Stellaria uniflora*, is the paludal plant of Torrey & Gray, Robinson and Small. Although Gray, supposing the latter to be Walter's *Stellaria uniflora*, renamed it *Alsine Walteri* Gray, Genera, ii. 34 (1849)—*Alsine* "Walteri (Stellaria uniflora, *Walt.*)", his new name must apply nomenclaturally to the plant of Walter, not to the one mistakenly taken for it. The paludal species should evidently be called

STELLARIA **paludicola,** sp. nov. (TAB. 1104), planta stolonifera stolonibus filiformibus diffusis repentibus; caulibus laxe adscendentibus vel diffusis pergracilibus ad 4 dm. longis glabris deinde ramosis; foliis linearibus vel oblanceolatis glabris primariis 1.5–4 cm. longis 1–4.5 mm. latis acutis; pedunculis axillaribus vel terminalibus valde adscendentibus 2–8 cm. longis; sepalis glabris lanceolatis acuminatis 3–5 mm. longis; petalis anguste cuneatis 6–10 mm. longis apice emarginatis; staminibus petalis brevioribus.—Shallow streams, pools, wet meadows, boggy depressions and grassy swamps, Florida and Alabama, north along the Coastal Plain to North Carolina. TYPE: edge of small stream, golf-links, Myrtle Beach, South Carolina, April 19, 1932, *Weatherby & Griscom*, no. 16,523 (in Herb. Gray.).

CUCUBALUS POLYPETALUS Walt. Fl. Carol. 141 (1788), under a genus defined "*Cal.* inflatus. *Petala*, fauce nuda. *Caps.* 3-locularis", was, obviously a *Silene.* The species was very briefly characterized:

polypetalus. foliis oppositis, ovato-lanceolatis; floribus polypetalis.

Asa Gray, in manuscript memoranda, as well as beside the specimen in the Fraser volume, stated that it is *Saponaria officinalis* with double flowers; but the specimen, no. 112 on page 38 (our PLATE 1105, FIG. 1) is quite evidently the summit of a flowering stem of *Silene Baldwynii* Nutt. Gen. i. 288 (1818), originally described with "petals divaricately laciniate (FIG. 2), the very narrow laciniae rendered by Walter "polypetalis". The long and narrow segments of the petals are displayed in Walter's specimen (although crumpled) as well as in the specimens of *Silene Baldwynii*. They do not occur in the flowers of *Saponaria officinalis* (FIG. 3). Index Kewensis hit somewhat nearer by identifying *Cucubalus polypetalus* with *Silene ovata* Pursh, in this following a suggestion made by Pursh himself. That tall species, however, has long acuminate leaves, a prolonged thyrse of relatively small flowers with the slender calyx in anthesis only 6–10 mm. long. Walter's species has the small bluntish leaves, corymbiform inflorescence and large calyx (in anthesis 1.8 cm. long) of *Silene Baldwynii*. It is, therefore, necessary to call it

SILENE **polypetala** (Walt.), comb. nov. *Cucubalus polypetalus* Walt. Fl. Carol. 141 (1788). *Silene Baldwynii* Nutt. Gen. i. 288 (1818).

In view of Asa Gray's unfortunate identification of *Cucubalus polypetalus* with the very different *Saponaria officinalis*, we quote, as did the late James Britten (in Journ. Bot. l. c. 70 (1921)) from the Letters of Asa Gray, i. 136 (1893) and append Britten's remarks.

"I . . . find the examination very tedious, as the specimens are very often not labeled, except with the genus in his 'Flora,' so that I have first to make out his own species, and then what they are of succeeding authors.

"The specimens are mostly mere bits, pasted down in a huge folio volume. I suspect this was done by Fraser, and the labels have sometimes been exchanged, so that it requires no little patience. Some of the things I most wished to see are not in the collection, and there are several in the collection which are not mentioned in the 'Flora'. You would laugh to see what some of the things are that have puzzled us: thus, for instance, his 'Cucubalus polypetalus' is Saponaria officinalis! His 'Dianthus Carolinianus' is Frasera! in fruit."

Britten added:

"Gray is probably right in his identification of the wretched specimen of '*C. polypetalus*' with *Saponaria*—though Pursh (Fl. Amer. Sept., 316) had doubtfully referred it to his *Silene ovata*, which is based on a speci-

men in Herb. Banks endorsed: 'Cherrokee Countrey, W. V. Turner, 1769: Indian name Ounenake Ounostaatse—White root': but the *Dianthus* is not *Frasera*, but *Dodecatheon Meadia*. Gray made notes on the collection which, or a copy, he sent to Torrey; if these are anywhere preserved, their publication would be of considerable interest."

Without very careful checking, Gray's note-book, before us, might be misleading, since, at the age of 28 and with limited knowledge of southern plants, his identifications were often based on familiarity with the flora of eastern New York.

ACTAEA PENTAGYNA Walt. Fl. Carol. 151 (1788), although not represented by any preserved specimen, was presumably *Anemonella thalictroides* (L.) Spach. Walter's description is good:

pentagyna floribus solitariis, pedunculis e sinu foliorum
2. ortis; corollis petalis septem obovato-oblongis, albis; pericarpio lanceolato monospermo; foliis biternatis, foliolis obtusis tridentatis.

Except for the "pericarpio . . . monospermo" the description could apply to *Isopyrum biternatum* (Raf.) Torr. & Gray, but *Isopyrum* has follicles with more than 1 seed and it is not reported from east of the Alleghenies. *Anemonella* is common in southeastern Virginia and extends across western Carolina to northern Florida. Its lanceolate achenes are 1-ovulate and, though commonly 7 or more, are frequently only 3 (or even 2 or 1). The disposition by *Index Kewensis* of *Actaea* "*pentagyna*, Walt. Fl. Carol. 151 = Cimicifuga americana" is far from satisfactory.

CHRYSOSPLENIUM OPPOSITIFOLIUM sensu Walt. Fl. Carol. 140 (1788), is a striking illustration of Walter's isolation from comparative material and of the Frasers' inaccuracy in guessing at the identities of the fragments they had from Walter. Walter was in doubt as to both genus and species, accompanying a compiled generic diagnosis by the generic name "183. CHRYSOSPLENIUM?" and considering his plant as possibly *C. oppositifolium* L., a Eurasian herb resembling our *C. americanum*. How far from the Eurasian plant was Walter's is shown by his description:

oppositifolium? 1. foliis oppositis luteis tomentosis ovatis sessilibus, caule aureo tomentoso.

The marginal memorandum in the hand which was presumably that of Dr. James Macbride (see below) gives the clue, for this reads "Eriogonum tomentosum Michx." The Fraser scrap-

book contains no specimen marked *Chrysosplenium* but on p. 38 there is a broken-off branch of an inflorescence of *Eriogonum tomentosum* bearing Fraser's label "F. 306 Cucumis", etc., an even more unfortunate identification than Walter's. Since the lower leaf-surfaces of *Eriogonum tomentosum* become fulvous in age, it seems evident that *Chrysosplenium oppositifolium* sensu Walter, not L., belongs in the synonymy of that species.

As stated, our clue to the above identification was the marginal memorandum made, evidently by James Macbride, a South Carolinian and contemporary of Stephen Elliott, in the copy of Walter's Flora Caroliniana which belonged to him from 1812–1816 and which, after passing through various hands, originally from Thomas Walter to John Watson, then to James M. Watson in 1789, then to Macbride, through J. M. Watson's daughter, Mrs. Catharine Davis, then by James Macbride to Jacob Bigelow and on through Francis Parkman to Charles Sprague Sargent, was finally reproduced and issued by Dr. E. D. Merrill in 1947. The marginal memoranda, apparently in the handwriting of Macbride, who knew the flora of Walter's region, are very significant. As stated, it was he who detected what Walter meant by *Chrysosplenium*.

The Type of Sophora villosa Walt. Fl. Carol. 134 (1788), our plate 1106, fig. 1, was very briefly described as follows:

> *villosa* 3. fol. ternatis lanceolatis, caule calycibusque villosis, floribus cinereis spica terminali.

The species was transferred to *Podalyria* as *P. villosa* (Walt.) Michx. and then to *Baptisia* by Nuttall. Elliott, Sk. i. 468 (1817), expressed some doubt as to the identity of the plant, saying "It is not improbable that Michaux has described, under this name, a different species from that of Walter". Torrey & Gray, Fl. N. Am. i. 384 (1843), similarly indicated doubt: "We have drawn up our description from the specimen of Mr. Curtis, which we think is the same with the plant of Michaux. We are doubtful, however, whether it be the Sophora villosa of Walter, in whose herbarium a portion of a raceme of the plant only exists; and in this the calyx is more villous."

The Walter type (fig. 1) consists of a portion of a spiciform raceme with the flowers subsessile, each subtended by an oblong

bract when young. The rachis and calyces are densely spreading-villous and the plant obviously has nothing to do with that which currently passes as *Baptisia villosa* (FIG. 5). In its subsessile flowers, oblong bracts and heavily villous rachis and calyx it is, however, closely matched by specimens of *Thermopsis caroliniana* M. A. Curtis (FIGS. 2–4). Although the latter varies in having the inflorescence open or relatively dense, the inflorescence of the Walter plant is readily matched by specimens of *T. caroliniana* with more open inflorescences. It therefore becomes necessary to call *T. caroliniana*

THERMOPSIS **villosa** (Walt.) comb. nov. *Sophora villosa* Walt., Fl. Carol. 134 (1788). *Thermopsis caroliniana* M. A. Curtis in Am. Jour. Sci. ser. I, xliv. 80 (1843). PL. 1106, FIGS. 1–4.

IN PLATE 1106 FIG. 1 shows a portion of the inflorescence of Walter's plant, × 1½; FIGS. 2–4, portions of the inflorescence of *T. caroliniana*, from North Carolina, also × 1½; and FIG. 5, a portion of the inflorescence from Virginia of *Baptisia cinerea*, which has erroneously passed as the same as the Walter plant, also × 1½.

Since the binomial, *Baptisia villosa*, was based on a plant which was not conspecific nor even congeneric with what usually passes as *Baptisia villosa*, the latter plant requires a new name. The only available name published for it seems to be *Lasinia cinerea* Raf., New Fl. N. Am. ii. 50 (1837), clearly a substitute for the *B. villosa* of authors. Rafinesque's account was as follows:

> "333. LASINIA CINEREA Raf. B. villosa of Authors, stem and leaves beneath pubescent, stipules linear, leaves subsessile, folioles elliptic obtuse—in Carolina, Michaux says the flowers are pale, Elliot calls them grey."

This necessitates the combination:

BAPTISIA **cinerea** (Raf.), comb. nov. *Lasinia cinerea* Raf., New Fl. N. Am. ii. 50 (1837). *B. villosa* sensu Nutt., Gen. N. Am. Pl. i. 281 (1818) and later auth., not *Sophora villosa* Walt., basonym. PLATE 1106, FIG. 5, × 1½.

In her monograph of the genus *Baptisia* (Ann. Mo. Bot. Gard. xxvii. 181 (1940)), Larisey cites, in the synonymy of *B. villosa*, *Lasinia fulva* Raf. l. c. 49, described from "Tennessee and Arkanzas", but she states the range of her *B. villosa* "coastal plain of Virginia, south to South Carolina" (page 182), and describes as

a separate plant, ×*B. stricta* Larisey, l. c. 166, from Arkansas and Oklahoma, stating that this is the *B. villosa* of recent authors in part (as to the plant of Arkansas) and on page 131 she specially points out that the plant which has been mistakenly called *B. villosa* in Arkansas is really her newly proposed ×*B. stricta*. It seems probable that ×*B. stricta* is antedated by Rafinesque's *Lasinia fulva* which he called "A very distinct sp. probably blended among *B. villosa* . . ."

ANONYMOS (Lupino affinis) ROTUNDIFOLIA Walt. Fl. Carol. 181 (1788), our PLATE 1107, FIGS. 1 and 2, the *Crotalaria rotundifolia* Poiret (1811) as to basonym, has usually been identified with *C. ovalis* Pursh (1814) and later, by Senn in RHODORA, xli. 341 (1939), with *C. angulata* Mill. (1768). This identification of Walter's plant was made by Gray in 1839, he then recording in his manuscript-notes under *Lupino affinis* that "*rotundifolia!* = *ovalis*". At that time, of course, only the single rounded-leaved and decumbent species was recognized in the southeastern states, the plant now called *C. angulata*, with leaves elliptic or elliptic-oblong and strongly rounded at both ends, the new growth, rachis, calyces, etc. rufescent or fulvous with spreading villosity. Subsequently, *C. maritima* Chapman (1883) has been separated out, a similar plant with short and appressed pilosity, the leaves subcuneately tapering to but slightly rounded at base. This more localized species is cited by Small as extending from Florida northward on the Coastal Plain to North Carolina, and Senn cites characteristic material of it from the neighborhood of Savannah, close to Walter's territory. It is, therefore, significant that the very well preserved TYPE or ISOTYPE of Walter's species on p. 67 of the Fraser volume (our FIGS. 1 and 2), which Gray examined, is of characteristic *C. maritima*. Walter's specific name was unfortunately selected but his "caule subdecumbente, foliis integris rotundatis pilosis" is all right if we take "rotundatis" to refer to the rounded summit of the leaf. The leaves of the preserved specimen from Walter exemplify Daydon Jackson's definition under "**rotund**′, *rotund′us* (Lat., round), rounded in outline . . . but a little inclined towards oblong"! It would seem, then, that we must take up Walter's name in a different sense than has been done:

CROTALARIA ROTUNDIFOLIA (Walt.) Poir. Encycl. Suppl. ii.

402 (1811), as to basonym, not as to plant described with "feuilles . . . arrondies, ... velues à leur insertion . . . ; pédoncules velus, un peu rousseâtres . . . bractées . . . velues; le calice velu"; not *C. rotundifolia* sensu later authors. *Anonymos rotundifolia* Walt. Fl. Carol. 181 (1788). *C. maritima* Chapm. Fl. So. U.S. ed. 2, Suppl. 614 (1883).

Var. **Linaria** (Small), comb. nov. *C. Linaria* Small, Man. Se. Fl. 679, 1505 (1933). *C. maritima*, var. *Linaria* (Small) Senn in Rhodora, xli. 347 (1939).

Hedysarum grandiflorum Walt. Fl. Carol. 185 (1788).—As Blake[1] pointed out, the name *Desmodium grandiflorum* (Walt.) DC., based on *H. grandiflorum* Walt., was incorrectly applied by American authors to *Desmodium glutinosum* (Muhl. ex Willd.) Wood (*D. acuminatum* (Michx.) DC.) for many years. On the basis of an examination and comparisons made of Walter's type at the British Museum by Mr. E. G. Baker, Blake recommended that the the name *D. grandiflorum* (Walt.) DC. be taken up for the plant long known as *D. bracteosum* (Michx.) DC. (and also, more correctly, as *D. cuspidatum* (Muhl. ex Willd.) Loud.). Recent examination of Walter's specimen, which is extremely fragmentary, confirms, nevertheless, the identity of his plant with those of Michaux and Muhlenberg.

In Rhodora, xxxviii. 96–97 (1936), Fassett showed that application of the homonym rule would preclude use of Walter's epithet, since it was a later homonym, antedated by *Hedysarum grandiflorum* Pall. (1773), and that, since a legitimate epithet was available in *Desmodium*, it must be used. The proper name to use for this species is, therefore,

Desmodium cuspidatum (Muhl. ex Willd.) Loud., Hort. Brit. 309 (1830) [incorrectly attributed to DC.]; Torr. & Gray, Fl. N. Am. i. 360 (1838).

Note on Impatiens biflora Walt. Fl. Carol. 219 (1788).—Apparently no type-material of this species is preserved, but a space on the page where it would be expected shows that a specimen has been destroyed. However, it seems to have been overlooked by American botanists that there is an earlier binomial which can hardly be set aside and which, without doubt, was based upon the familiar American plant. This was *Impatiens capensis* Meerburgh, Afb. Zeldz. Gewass. t. x (1775); Pl. Rar.

[1] Blake, S. F. in Bot. Gaz. lxxviii. 277, 278 (1924).

t. x (1789). Meerburgh, having cultivated plants in Holland, unfortunately assumed that they had originated at the Cape of Good Hope; but his beautiful life-sized colored plate is clearly that of *I. biflora* Walter which was published thirteen years later. Meerburgh's description was good:

> "IMPATIENS (Capensis) TAB. X.
> Planta annua, sub dio laete crescens, ad altitudinem quatuor pedum, caules lucide rubescunt, geniculatae, stabiles, rami alterni teretes, flores lutei intus rubro maculati;
> Habitus Impatientis Noli-tangere.
> Habitat ad Promontorium Bonae. Sp."

A portion of his plate, from the second reference cited above, is reproduced, without color, × 1, as our PLATE 1108.

Attention was directed to Meerburgh's species by G. M. Schulze in Notizbl. Bot. Gart. Mus. Berlin-Dahlem, xiii, nr. 120: 662–665 (1937), Schulze pointing out that *I. capensis* Meerb. is not the same as *I. capensis* Thunb., Prod. Fl. Cap. 41 (1794), the latter being a species actually of the Cape; while the former, although not positively identified by Schulze, was a plant unknown from the Cape, for which he suggested identity with Walter's species. Somewhat later B. L. Burtt, under the title "MEERBURGH'S IMPATIENS CAPENSIS", discussed the matter at length in Kew Bulletin for 1938, no. 4: 161–163, demonstrating by a study of the literature of the period that plate 10 was the last plate of the first part of Meerburgh's great illustrated work and that it was definitely published in 1775; Burtt saying in part:

> "A glance at the plate is sufficient to show that it is quite different from any of the South African balsams and it may, I think, be easily recognized as *Impatiens biflora* Walt. (*I. fulva* Nutt.), a common North American species now naturalized in several parts of Britain. There is no specimen of Meerburgh's now in existence and Schulze (l. c.) is of the opinion that the plate cannot be identified as *I. biflora* with absolute certainty; he therefore ranks *I. capensis* as 'species incerta'. Several botanists at Kew, however, have recognized the illustration of *I. capensis* as *I. biflora*, and there does not seem to be sufficient doubt to justify the rejection of Meerburgh's name. *I. capensis* Meerburgh (1775) clearly antedates *I. biflora* Walt. (1788) and must therefore stand as the correct name for the North American species, although the specific epithet is unfortunately quite inappropriate."

Since there seems no way to avoid the inappropriate binomial,

Impatiens capensis Meerb., it is necessary to make the following minor transfers:

I. CAPENSIS Meerb., forma **immaculata** (Weatherby), comb. nov. *I. biflora* Walt., f. *immaculata* Weatherby in RHODORA xix. 117 (1917).

Forma **citrina** (Weatherby), comb. nov. *I. biflora* Walt., f. *citrina* Weatherby in RHODORA l. c. 115.

Forma **albiflora** (Rand & Redfield), comb. nov. *I. fulva* Nutt., f. *albiflora* Rand & Redfield, Fl. Mt. Desert, 88 (1894); *I. biflora* Walt., f. *albiflora* (Rand & Redfield) Weatherby in RHODORA l. c. 115.

Forma **Peasei** (A. H. Moore), comb. nov. *I. biflora* Walt., f. *Peasei* A. H. Moore ex Weatherby in RHODORA l. c. 116.

Forma **platymeris** (Weatherby), comb. nov. *I. biflora* Walt., f. *platymeris* Weatherby in RHODORA xxi. 99 (1919).

HYPERICUM DENTICULATUM Walt. Fl. Carol. 190 (1788) is represented by no material but the description is a good one for the plant of the Coastal Plain from New Jersey to South Carolina which Michaux described as *H. angulosum* Michx. Fl. Bor.-Am. ii. 78 (1803). In fact, Michaux himself thought, correctly it would seem from his type of *H. angulosum* (our PLATE 1109, FIG. 1, × ½) and from abundant material from Walter's general region in eastern South Carolina (our PLATE 1109, FIG. 2), that his newly proposed species might be Walter's *H. denticulatum*. Walter's description of his species, standing between and allied to his *H. pilosum* (*H. setosum* L.) and his *H. quinquenervium* (*H. mutilum* L.), was as follows:

> *denticulatum* 5. floribus trigynis submagnis, petalis dente unico laterali, caule erecto quadrangulo, foliis subamplexicaulibus crassis ovatis.

Michaux's account of his *H. angulosum* was similar:

> ANGULOSUM. H. herbaceum, erectum, quadrangulum: foliis lanceolato-ovalibus, acutis: panicula dichotoma, distanter alterniflora: calyce inferne anguloso.
> *H. denticulatum?* WALT.
> *OBS.* HYPERICO *canadensi* paulo majus. Folia arcte sessilia, erectiuscula, 5-nervia. Flores pusilli; calyce subcampanulato; foliolis oblongis, inferne prominenti-carinatis.
> *HAB.* in paludosis Carolinae.

The short and narrowly oval or ovate leaves rounded to subamplexicaul bases and the broad sepals characterizing typical *H. denticulatum* (*H. angulosum*), contrasted with the mostly much

longer and narrowly elliptic-oblong leaves with acute or subacute bases of the plant which Blake in RHODORA, xvii. 134 (1915) treated as typical *H. denticulatum*. As synonyms of the plant with narrower and acute-based leaves Blake gave "*H. virgatum* Lam. Encyc. iv. 158 (1796); *H. angulosum* Michx."; and he treated the plant with short ovate or oval leaves, so frequent in the Pine Barrens of New Jersey, thence to the Coastal Plain of the Carolinas (the plant described by Walter and by Michaux) as "H. DENTICULATUM Walt. var. **ovalifolium** (Britton) Blake (*H. virgatum ovalifolium* Britton, Trans. N. Y. Acad. Sci. ix. 10 (1889)". Forthwith, as true *H. denticulatum* (originally described "foliis subamplexicaulibus. . . ovatis") there appears in Small, Man. 870 (1933) the plant with "leaf-blades elliptic or nearly so, 1–3 cm. long, acute (oval and relatively shorter, with the sepals oval to ovate, in *H. denticulatum ovalifolium*)".

As a matter of fact, true *H. denticulatum* has the larger round-based leaves only 0.8–2 (rarely –2.5) cm. long and mostly 0.6–1.7 cm. broad, while the reputed but obviously not typical "*H. denticulatum*" has the larger acutish- to acute-based leaves 1.5–3.5 cm. long and 4–10 mm. broad. This plant (our PLATE 1110), then, stands between short- and broad-leaved true *H. denticulatum* and the extreme with all or at least the upper nearly linear leaves sharply pointed, the upper cauline leaves (the lower ones often broader) 1–3.5 cm. long and only 1.5–7 mm. broad. The latter is *H. denticulatum*, var. *acutifolium* (Ell.) Blake, l. c., based on *H. acutifolium* Ell. Sk. ii. 26 (1821), Elliott's type, × ½, shown in our PLATE 1111, FIG. 2[1]. Had those who have recently pronounced on the identities here involved read Walter's "foliis subamplexicaulibus . . . ovatis" they would not have rendered it as "elliptic or nearly so" and then separated from it as a different variety plants with ovate or oval leaves; and they would not have placed Lamarck's *H. virgatum* (type shown, × ½, in our PLATE 1111, FIG. 1), which was correctly described: "feuilles . . . sessiles, amplexicaules, linéaires-lancéolees, étroites, un peu pointues, entières, . . . les plus grandes, d'environ un pouce sur une largeur de trois à quatre lignes", in the synonymy of the restricted *H. denticulatum*.

[1] The stained paper on which Elliott's type is preserved is due to the long storage, during and after the Civil War, of the herbarium in a damp basement.—See Weatherby in RHODORA, xl. 250 (1942).

At least four numbers of *H. denticulatum*, var. *acutifolium* were distributed by Dr. R. M. Harper without identifications, as nos. 457, 1006, 1028 and 1731, from pinelands of Sumter County, Georgia. Evidently thinking that the labels needed completion, Dr. Robert Keller, who habitually assumed that our eastern North American plants awaited recognition[1], described three numbers as a new species, *H. Harperi* Keller in Engler, Bot. Jahrb. lviii. 198 (1923), he defining Harper's definitely soboliferous, soft-based herbaceous specimens as "suffruticosum, e rhizomate lignoso" and comparing them only with the strictly annual *H. Drummondii* (Grev. & Hook.) T. & G. Had he understood American botanical literature and plants he could have found it already described several times, beginning in 1797. A portion of a cotype (no. 1006)[2] of *H. Harperi* is shown, × 1, in PLATE 1111, FIG. 3. That it belongs with *H. denticulatum*, var. *acutifolium* seems apparent.

Ranges of (1) HYPERICUM DENTICULATUM, VAR. TYPICUM; (2) VAR. RECOGNITUM; (3) VAR. ACUTIFOLIUM.

Although the three varieties may merge and nondescript individuals can be found, while var. *acutifolium* is sometimes associated with the broader- and less attenuate-leaved plant in the southern part of their range, they are generally quite distinct and, as shown in the Gray Herbarium, they have distinctive areas. The maps here published show the localities of all specimens in the Gray Herbarium. They clearly indicate definite centers of development. The three varieties are

HYPERICUM DENTICULATUM Walt., var. **typicum.** *H. denticulatum* Walt. Fl. Carol. 190 (1788). *H. angulosum* Michx. Fl.

[1] See discussion of his new *Polygonum* by Fernald in RHODORA, xlviii. 53 (1946).

[2] Although Keller cited three numbers, he gave the detailed data for only one of them, no. 1028. This we, therefore, designate as the type.

Bor.-Am. ii. 78 (1803). *Brathys denticulata* (Walt.) Spach in Ann. Sci. Nat. sér. 2, v. 367 (1836), wrongly ascribed to Kunth: "B. DENTICULATA Kunth (sub Hyperico)". *B. linoides* Spach, Hist. Nat. Vég. v. 452 (1836), renaming (illegitimate) of *H. angulosum* Michx. *H. virgatum* var. *ovalifolium* Britton in Trans. N. Y. Acad. Sci. ix. 10 (1889). *H. denticulatum*, var. *ovalifolium* (Britton) Blake in RHODORA, xvii. 135 (1915).—Coastal Plain, New Jersey to South Carolina and presumably Georgia; Coffee Co., Tennessee. PLATE 1109. MAP 1.

Var. **recognitum,** var. nov. (TAB. 1110, × 1), foliis anguste ellipticis vel elliptico-oblongis vel anguste obovatis basin versus acutis apice acutis vel obtusis, laminis 1.5–3.5 cm. longis 4–10 mm. latis.—Georgia to Mississippi, northward (mostly in the upland and mountainous areas, barely reaching the inner margin of the Coastal Plain) to southeastern Virginia, southern West Virginia, Kentucky and southern Indiana. TYPE from moist ground, Knoxville, Tennessee, July, 1895, *A. Ruth* in Herb. Gray. MAP. 2.

This variety was taken by Blake and by Small to be typical *H. denticulatum*.

Var. ACUTIFOLIUM (Ell.) Blake, l. c. 134 (1915). *H. virgatum* Lam. Encyc. iv. 158 (1796). *H. acutifolium* Ell. Sk. ii. 26 (1821). *H. virgatum*, var. *acutifolium* (Ell.) Coulter in Bot. Gaz. xi. 106 (1886). *H. Harperi* Keller in Engler, Bot. Jahrb. lviii. 198 (1923).—Rather local, northern Florida, northward on Coastal Plain and upland to North Carolina, southern Virginia and central Tennessee. PLATE 1111. MAP 3.

Var. *acutifolium* is often much taller than the other varieties, large specimens up to 1 m. or more in height, whereas the other two varieties rarely exceed 6.5 dm. in height.

Although Coulter in Gray, Synopt. Fl. N. Am. i[1]. 288 (1897) cites unequivocally as a synonym of *Hypericum virgatum* Lam. the later *H. hedyotifolium* Poir. Suppl. iii. 700 (1813) from Nova Scotia, it is clear that Poiret's species could not have been any form of *H. denticulatum*. Poiret's "Espèce remarquable par sa délicatesse . . . hautes de quatre pouces, . . . les feuilles . . . linéaires, obtuses, droites, longues de quatre lignes, larges d'une ligne . . . ; les fleurs petites; . . . les bractées petites, lancéolées, aiguës: la corolle . . . plus courte que le calice", etc. indicate that he had tiny plants of *H. canadense* L., such as abound in Newfoundland and Nova Scotia.

(To be continued)

STUDIES OF AMERICAN TYPES IN BRITISH HERBARIA

M. L. Fernald and Bernice G. Schubert

(*Continued from page 208*)

Sium suave Walt. Fl. Carol. 115 (1788).—In Rhodora, xlv. 454 (1943) the senior author, recording the extension northward into southeastern Virginia of *S. floridanum* Small, Man. Se. Fl. 976, 1506 (1933), suggested that the type of Walter's species could have been a specimen of the latter species. Fortunately, however, the fragment preserved in the Walter collection is from perfectly characteristic material of the wide-ranging northern, as well as southern, plant, with stiffly ascending and strongly corrugated stems, relatively coarse rays of the umbel and very numerous flowers in the umbellets, of the plant now generally known as *S. suave*.

A synonym of *S. floridanum* is *S. lineare* Michx., β. *intermedium* Torr. & Gray, Fl. i. 611 (1840). One of Chapman's original specimens in the Gray Herbarium is definitely of *S. floridanum*. Should the latter eventually be placed under *S. suave* as an extreme variation, Torrey & Gray's varietal name will have to be considered.

Angelica lobata Walt. Fl. Carol. 115 (1788).—The type, a badly crumpled leaf is, without doubt, from a plant of *Ligusticum canadense* (L.) Britt., as already suggested by Mathias & Constance in N. Am. Fl. 28b. 145 (1944), a characteristic woodland species of the southeastern states.

LEUCOTHOE **editorum,** nom. nov. *L. Catesbaei* sensu Gray, Man. ed. 2, 252 (1856), not *Andromeda Catesbaei* Walt. Fl. Carol. 137 (1788), basonym.

In RHODORA, xlvii. 169–171 (1945), the senior author pointed out the utter confusion which has existed as to the true basis of *Leucothoe Catesbaei*, through the fact that Walter's type had not been clearly understood and that Pursh in describing *Andromeda spinulosa* had well defined the montane species but had given the locality as "Lower Carolina" and had cited *A. Catesbaei* Walt. as an exact synonym.

The Walter type (572), clearly labeled *Andromeda Catesbaei*, proves to be a flowering branch of very characteristic *Leucothoe axillaris* (Lam.) D. Don or *Andromeda axillaris* Lam. Encycl. i. 157 (1783). In the Synoptical Flora of North America, ii[1]. 34 (1878), Gray treated the montane species with caudate-attenuate leaf-tips and acutish bracts and sepals as *L. Catesbaei*, with the synonym *A. spinulosa* Pursh "excl. habitat"; and he added the parenthetical note, "Pursh characterized the two species but transposed the habitats", Pursh having cited the coastwise *Andromeda axillaris* as "on the mountains" and, as already noted, his *A. spinulosa* from the low country. Since *Andromeda spinulosa* Pursh had the exact synonym *A. Catesbaei* Walt., it must be treated as having an illegitimate name because Pursh should have used the earlier name which he cited. Other names which have been assigned to the synonymy of the montane shrub, *Leucothoe editorum*, are *Andromeda Walteri* Willd. Enum. 453 (1809), a renaming of *A. Catesbaei* Walt., and *A. lanceolata* Desf. Cat. Pl. Hort. Paris, 136 and 398 (1829), an unencumbered name but unfortunately antedated by *A. lanceolata* Wallich (1820) and *A. lanceolata* Vell. (1825). There seems, therefore, to be no binomial except possibly the later homonym, *Andromeda lanceolata* Desf., available which can legitimately be taken up for the plant which has erroneously passed as *L. Catesbaei*.

It is important to record the fact that it was clearly stated in his manuscript notes of 1887 by Asa Gray of "'Andromeda Catesbaei 572'. It is A. axillaris!" Apparently Gray found no opportunity to make the correction.

ASCLEPIAS POLYSTACHIA Walt. Fl. Carol. 107 (1788) was well described:

polystachia 13. fol. petiolatis oppositis lanceolatis laevibus, subtus venosis umbellis pluribus terminalibus lateralibusque, petalis et auriculis corniculatis purpurascenti-rubris, corpusculo latere fusco, apice albo; caulis 4-pedalibus.

This description, with "fol. petiolatis . . . lanceolatis laevibus, . . . umbellis . . . terminalibus lateralibusque", is so little suggestive of *A. rubra* L. which has, to quote Gray (Syn. Fl.), "leaves . . . tapering from near the rounded or obscurely cordate base to an acuminate apex", that it is surprising that Gray, Syn. Fl. ii[1]. 90 (1878), should have suggested the identity of *A. polystachia* (although with a saving "?") with *A. rubra*. He also suggested, likewise with a query, the identity of *A. cordata* Walt., l. c. 105, with *A. rubra*. There is no preserved specimen of the latter but Walter's "fol. cordato-lanceolatis subsessilibus" and his other characters pretty definitely indicate that his *A. cordata* is *A. rubra* L. (1753).

Walter's account of his *A. polystachia* is very similar to Gray's (Syn. Fl.) description of the leaves of *A. phytolaccoides* Pursh and Small's (Man.) account of the same species, as the earlier *A. exaltata* "(L.) Muhl.", that one automatically looks for a Walter specimen to match these accounts. Gray has "Bright green and glabrous: stem 4 or 5 feet high: leaves membranaceous, from oval to ovate-lanceolate, acuminate at both ends, short-petioled, 4 to 8 inches long" (compare "fol. petiolatis . . . lanceolatis laevibus"—*Walt.*). Small, describing the flowers of the same species, which extends southward to Georgia and Mississippi, says: "corolla-lobes greenish or greenish-purple . . . : hoods . . . white or flushed with pink" (compare "petalis et auriculis corniculatis purpurascenti-rubris, corpusculo latere fusco, apice albo"—*Walt.*). Fortunately, on p. 10 of the Fraser volume there is a comparatively good foliage-specimen of "Asclepias Novum" with the ovate-lanceolate leaves acuminate to both ends, petioled and with the venation of the leaves of characteristic *A. exaltata* or *phytolaccoides*.

From the bibliography given by Britton & Brown, iii. 9 (1898),

A. Syriaca var. *exaltata* L. Sp. Pl. Ed. 2, 313. 1762.
Asclepias exaltata Muhl. Cat. 28. 1813.
A. phytolaccoides Pursh, Fl. Am. Sept. 180. 1814,

one might infer that Walter's binomial of 1788 should be taken

up, but Muhlenberg happened, although citing no basonym nor giving any diagnosis, to hit on the correct binomial; for in Species Plantarum, ed. 2, l. c., Linnaeus cited under his *A. syriaca*, β. *exaltata* an earlier reference. Following this back we find the *species*, properly with a binomial and a very detailed description, as A. EXALTATA L. in Amoen. Acad. iii. 404 (1756). That is the correct binomial.

ORIGANUM FLEXUOSUM Walt. Fl. Carol. 165 (1788), our PLATE 1112, was one of two new species described by him under a genus defined "*Involucrum* multisetum verticillo subjectum" etc.; *i. e.* his *Origanum* was primarily the species of *Pycnanthemum*, § *Tullia* Benth., with bristle-tipped calyx-teeth. Walter's description was

flexuosum 2. An satureja virginiana? LINN. — capitulis axillaribus, floribus sessilibus, bracteis quam corollulae minoribus, caule flexuoso, foliis sublinearibus.

This species is one of the two of the genus represented, without specific name, on p. 79 in the Fraser series. The specimen (our PLATE 1112, FIG. 1, × ⅔, FIG. 2, × 3) is an unusually good one of the characteristic plant of Walter's region with heads on axillary branches, calyx-lobes aristate, stem often flexuous and leaves "sublinear" (linear-oblong to narrowly oblong-lanceolate and blunt, entire or nearly so) which was described as *Pycnanthemum hyssopifolium* Benth. (1834), almost as if he had Walter's specimen before him: "foliis subsessilibus oblongo-lanceolatis linearibusve obtusis subintegerrimis . . . , verticillastris paucis multifloris laxiusculis, bracteis subulatis aristatis extimis oblongis, calycis dentibus subaequalibus subulatis rigidis". There is no question about the true identity of *Origanum flexuosum* Walt. with the consequent carelessly made combination, PYCNANTHEMUM FLEXUOSUM (Walt.) BSP., Prelim. Cat. N. Y. Pl. 42 (1888), the combination unintelligently published without bibliographic citation as P. "flexuosum, (Walt.) (*P. linifolium, Pursh.*)", unintelligently because the Walter description and plant are of a section very distinct from that containing Pursh's *P. linifolium!* In Mem. Torr. Bot. Cl. v. 279 (1894) Britton clarified the essential bibliography by basing *Koellia flexuosa* (Walt.) Britton on *Origanum flexuosum* Walt. Fl. Carol. 165 (1788), overlooking the

fact that the combination *K. flexuosa* (Walt.) MacMillan, based on "*Nepeta* [instead of *Origanum*] *flexuosa* Walt.", without citation of page (presumably not seen by MacMillan), was published in Metasp. Minn. Val. 452 (1892), for a mixture of three species said to grow in Minnesota, at least 650 miles northwest of the western limit of Walter's species. Britton gave other synonyms, including *P. linifolium* Pursh (1814) and "*Satureia Thymus Virginicus* L. Mant. 2: 409 (1771)".

Before discussing the latter names it should be noted that Grant & Epling, *Study of Pycnanthemum*, Univ. Calif. Pub. Bot. xx. no. 3: 224 (1943), explicitly say, we know not why: "there are no specimens of this species [Walter's *Origanum flexuosum*] among the Walter plants in the British Museum; *P. aristatum* is represented, however". Since *P. aristatum* Michx. (i. e. *P. setosum* Nutt.—see Fernald in RHODORA, xlvii. 178 (1945)) has, as correctly described by Grant & Epling "leaf blades narrowly ovate, infrequently ovate-lanceolate, usually rather acute, . . . 1–3 cm. broad", it is difficult to understand how the Walter specimen could have been so misidentified; there is nothing preserved in the Fraser series but this one easily identifiable specimen and two unmatched fragments which have subulate-aristate calyx-lobes but very narrowly linear leaves. These fragments, which are surely not of the section *Brachystemum* Benth., which contains *P. linifolium*, definitely belong, like *P. setosum* and true *P. flexuosum* (*P. hyssopifolium*) to § *Tullia* and apparently represent an unrecognized species, which should be sought in eastern South Carolina.

In the synonymy of *Koellia flexuosa* sensu Britton, l. c., excluding basonym, there appears another name which was published earlier than *Brachystemum linifolium* Willd. Enum. 623 (1809), basonym of *Pycnanthemum linifolium* (Willd.) Pursh, Fl. Am. Sept. ii. 409 (1814). This was the already quoted "*Satureia Thymus Virginicus*" L. Mant. ii. 409 (1771) which leads us to the Linnaean account. This gives no justification for the trinomial listed by Britton, for here is what Linnaeus said:

> Satureja *virginic.* THYMUS capitulis terminalibus, caule erecto, foliis lanceolatis *rectius.*

Without further explanation it would seem that here was a variant of the old and much confused *S. virginiana* L. (1753),

which has been well established in the sense of *P. lanceolatum* Pursh (see Grant & Epling, l. c. 221). Grant & Epling cite under *Pycnanthemum flexuosum* in their sense the synonym *Koellia capitata* Moench, Meth. 408 (1794) which, obviously antedates *Brachystemum linifolium* Willd. (1809) and *Pycnanthemum linifolium* (Willd.) Pursh, but Moench, describing a plant "foliis lanceolatis", cited as an unquestioned synonym "*Thymus virginicus. Linn.*". Since he did not take up this earlier name Moench's name was illegitimate; its lanceolate leaves are not good for *P. linifolium*. Incidentally, Grant & Epling, with many collections before them could map the latter species (their map 11) from South Carolina only from the mountains, and assiduous collectors have not secured it from the Coastal Plain south of North Carolina. In other words it is not known from near Walter's home, where the plant Walter described and collected abounds (see Grant & Epling, map 13). With many stations recorded in eastern but none in western South Carolina and copious material from Walter's own county the identity of his species might have been surmised.

The upshot seems to be that, since the preserved specimen which exactly coincides with Walter's description of his *Origanum flexuosum*, is characteristic *Pycnanthemum hyssopifolium*, we are forced to a change:

Pycnanthemum flexuosum (Walt.) BSP. Prelim. Cat. N. Y. Pl. 42 (1888), as amplified by Britton in Mem. Torr. Bot. Cl. v. 279 (1894) as to basonym, not sensu BSP. *Origanum flexuosum* Walt. Fl. Carol. 165 (1788). *P. hyssopifolium* Benth. Lab. Gen. Sp. 329 (1834). *P. aristatum* Michx., var. *hyssopifolium* (Benth.) Gray, Syn. Fl. N. Am. ii[1]. 354 (1878). *Koellia flexuosa* (Walt.) MacMillan, Metasp. Minn. Val. 452 (1892) as to name only; sensu Britton in Mem. Torr. Bot. Cl. v. 279 (1894), not as to other synonyms.

We now reach the stiffly branched and tough (not "flexuous") plant, of Bentham's § *Brachystemum*, which has been erroneously passing as *Pycnanthemum flexuosum*. That it is *P. linifolium* (Willd.) Pursh, Fl. Am. Sept. ii. 409 (1814), based on *Brachystemum linifolium* Willd. Enum. Hort. Berol. 623 (1809), there is no doubt; but it is also *P. tenuifolium* Schrader, Hort. Gott. 10, tab. iv (1809). Schrader gave a very full analytical description of the plant (unfortunately said to have its "Habitat in Archi-

pelago") and a full-size colored plate of our common linear-leaved species which Willdenow defined the same year. But by present rules of nomenclature Willdenow's *Brachystemum linifolium* was an illegitimate name for, after a two-line diagnosis, Willdenow cited as exact synonyms the earlier *B. virginicum* Michx., which rested on *Thymus virginicus* L., and also *Thymus virginicus* of "Sp. pl. ed. W. 3. p. 145". Since the *Thymus virginicus* of Willdenow's Species was the *T. virginicus* L., Willdenow should have retained the original specific epithet. Thus, although published slightly later, *Pycnanthemum tenuifolium*, beautifully described and illustrated and without citation of an earlier name, is the legitimate name of the plant, the bibliography of which is

PYCNANTHEMUM TENUIFOLIUM Schrader, Hort. Gott. 10, t. iv (1809). *Satureja virginiana* L. Sp. Pl. ii. 567 (1753) in part only. *Thymus virginicus* L. Mant. ii. 409 (1771), in part only, renaming of the preceding. *Brachystemum virginicum* Michx. Fl. Bor. Am. ii. 6 (1803) as to plant only. *B. linifolium* Willd. Enum. 623 (1809) as to plant, name illegitimate. *P. linifolium* Pursh, Fl. Am. Sept. ii. 409 (1814). *P. flexuosum* sensu BSP. Prelim. Cat. N. Y. Pl. 42 (1888), as to plant, not as to basonym. *Koellia flexuosa* MacMillan, Metasp. Minn. Val. 452 (1892) in part only, not as to basonym; Britton in Mem. Torr. Bot. Cl. v. 279 (1894) as to plant, not as to basonym.[1]

COLLINSONIA SEROTINA Walt., Fl. Carol. 65 (1788), was well described "fol. magnis oppositis ovatis, petiolis longis, *supremo pari unice sessili, cordato;* panicula terminali ramosissima". Asa Gray, in the Synoptical Flora, ii[1]. 351 (1878), cited it without question as identical with *C. punctata* Ell., Sk. i.36 (1816), which he treated as *C. canadensis*, var. *punctata* (Ell.) Gray. The species is now often treated as distinct and in such cases Walter's name should have precedence over Elliott's. In the varietal category Elliott's epithet is applicable.

PINGUICULA CAERULEA Walt. Fl. Carol. 63 (1788), as represented in the Fraser series of Walter's plants, our PLATE 1113, FIG. 3, × ca. ⅓, well illustrates the almost absurd confusion made

[1] On sheets in the Gray Herbarium we find the following combination which should be published, as it indicates the correct status of the plant:

PYCNANTHEMUM TORREI Benth., var. **leptodon** (Gray) Boomhour, comb. nov. in Herb. Gray. *P. pilosum* Nutt., β. *leptodon* Gray in Am. Journ. Sci. xlii. 46 (1842). *P. leptodon* Gray, Syn. Fl. N. Am. ii[1]. 355 (1878).

by Fraser or the Frasers in attempting to identify the specimens or fragments. On page 83 of the series a small umbel, FIG. 1, mounted just above the properly identified *Pinguicula lutea* Walt. (FIG. 2), bears Fraser's label "*Pinguicula caerulea*". Asa Gray, as shown in his manuscript notes, recognized that this fragment is an inflorescence of *Oxalis violacea.* However, on another page (no. 526 on p. 80), there is a different specimen, correctly called *O. violacea,* this one with bulb and leaves, as well as umbel. Finally, specimen no. 487 on p. 104, bearing the appended name "*Utricularia gibba*", solves the mystery, for this is a plant of *Pinguicula* (our FIG. 3, × ca. ⅓) with dark and opaque rosette-leaves and a characteristic flower, which is readily matched (as to profile) by such a representative sheet of *P. elatior* Michx. (1803) as that of *F. W. Hunnewell,* no. 8115 (FIG. 4), from Summerville, South Carolina. The decision by Barnhart in Addisonia, xviii. 21, t. 587 (1933), to take up P. CAERULEA Walt. (1788) instead of *P. elatior* Michx. (1803) seems quite justified. In fact, when he published *P. elatior* Michaux himself suggested that it might be Walter's *P. caerulea.*

DIANTHERA OVATA Walt. Fl. Carol. 63 (1788) was well described but there seems to be no specimen preserved. It was transferred in 1900 to *Justicia* as *J. ovata* (Walt.) Lindau in Urban, Symb. Antill. ii. 237 (1900). In RHODORA, xliii. 641 (1941) the senior author took up for it the later *J. humilis* Michx. (1803) because *J. ovata* Dietrich in Steudel, Nom. ed. 2, i. 838 (1840) seemed to invalidate Lindau's combination. Unfortunately, however, as we are now beginning to understand, many names newly published by Steudel are illegitimate and have no nomenclatural force because they were published as synonyms only. Examination of the name *J. ovata* Dietr. clearly shows that it was a mere synonym. On p. 838 of Steudel it appeared in italics (as a synonym) under *Justicia* as "*ovata. Dietr.* Dicliptera peruviana" and on p. 504, under the maintained *Dicliptera* (with *Justicia* as a generic synonym) D. "peruviana. Juss." had the synonym *Justicia ovata* Dietr. Index Kewensis also lists *J. ovata* E. Meyer in Drège, Zwei Pfl. Docum. (Flora, xxvi². Beig.) 196 (1843), from South Africa. There again the name had no nomenclatural force for it was a *nomen nudum.* In enumerating the plants of different localities Drège listed on p. 149, his no.

4818 as "Justicia ovata, 4818". Then on p. 196, in an alphabetical list of his South African plants, he gave *Justicia* "ovata E.M.)". That seems to be the full publication of *J. ovata* E. Meyer. Later authors have regularly cited it in the synonymy of the species with which the Drège material has been identified but they do not seem to have defined it as *J. ovata*. Thus, Presl, Bot. Bemerk. 95 (1844), without a word of definition, said "Justicia ovata E. Meyer in Drege—est Dicliptera ovata Presl". In his treatment of the *Acanthaceae* in DC. Prodr. xi. 336 (1847) Nees ab Esenbeck described in detail the Drège material as *Rhytiglossa ovata*, with the synonym "Justicia ovata E. Meyer! cat. pl. Drèg." but the latter name can hardly be said to have been defined, except as a synonym. Similarly, C. B. Clarke in Thiselton-Dyer, Fl. Capensis, v[1]. 80, 81 (1901) takes up *Isoglossa* "**ovata** (Lindau in Engl. & Prantl, Pflanzenfam. iv. 3B. 344)", giving a full description of the South African plant with the synonym "*Justicia ovata, E. Meyer in* Drège" etc. cited, as if that name had been defined. Just to show how hit-or-miss is the bibliographic work of too many of us (and we all get caught unless we scrupulously verify citations) we may turn to Clarke's reference (correct it would seem) to *Isoglossa ovata* Lindau in Engler & Prantl. Turning to the reference we find under *Isoglossa* "*I. ovata* (Nees) Örst." along with many other binomials referred to Örsted; but, unhappily, Örsted in publishing the genus *Isoglossa* in Kjoeb. Vidensk. Meddel. for 1854: 155 (1855) made no combinations, merely saying, after his definition of the genus "Rhytiglossa ciliata et ceterae species capenses huc pertinent". According to *Index Kewensis* this constituted the publication of *I. ciliata*, but, even admitting that it does do so (by the International Rules), Örsted certainly did not there publish *I. ovata*. The primary author of the trivial name *ovata* for the South African plant seems to be Nees. It surely can not be taken up as based on the undescribed *Justicia ovata* Dietr. with which this complicated digression began. But the combination JUSTICIA OVATA (Walt.) Lindau should stand for the North American plant which was later defined as *J. humilis* Michx.

EUPATORIUM PILOSUM Walt. Fl. Carol. 199 (1788) (our PLATE 1114, FIG. 1, × ⅖; FIGS. 2 and 3, × 2), described: "foliis lanceolato-ovatis, basi obtusis, serratis sessilibus, calycibus pilosis",

has very generally been thought possibly to be the same as *E. verbenaefolium* Michx. (1803), which antedates the identical *E. teucrifolium* Willd. (1804). Thus Gray, Syn. Fl. N. A. i². 99 (1884), taking up *E. teucrifolium*, gave as its first synonym "*E. pilosum*, Walt. Car. 199?". This interrogated identity is given in Index Kewensis, doubtless following Gray, and Britton & Brown give it (also with the interrogation) under *E. verbenaefolium*. Walter's description obviously applies to this common species of his region, in which the leaves of the primary axis are rounded to sessile bases, the reduced upper ones either sessile or with very short petioles. On the three pages of Fraser's series of Walter plants only one individual agrees with Walter's diagnosis. That, no. 755 (on p. 45), is a very characteristic inflorescence, with the lance-ovate, serrate and roundish-based leaves (although very short-petioled) of thoroughly typical *E. verbenaefolium*, the type of the latter and a pilose involucre ("calycibus pilosis") shown in RHODORA xlvii. t. 910 (1945). The Walter specimen could well have been the pattern for the inflorescence of *E. verbenaefolium* shown in Britton & Brown, Ill. Fl. iii. fig. 3624, p. 310 (1898). There seems no valid reason further to doubt that EUPATORIUM PILOSUM Walt. (1788) is the earliest and correct name for *E. verbenaefolium* Michx. (1803) or *E. teucrifolium* Willd. (1804).

EUPATORIUM LINEARIFOLIUM Walt. Fl. Carol. 199 (1788). It has generally been inferred, without examination of Walter's material, that *E. linearifolium* is the extreme and wide-ranging variety of *E. hyssopifolium* L. with very narrowly linear or linear-oblanceolate leaves only 0.5–5 mm. broad, these opposite or most often in whorls of 4 or 6 and subtending very dense suppressed axillary branchlets of fascicled shorter leaves. Following this common interpretation the senior author named and illustrated this commonest variety of *E. hyssopifolium* as var. *linearifolium* (Walt.) Fernald in RHODORA, xliv. 460, pl. 737, fig. 3 (1942). Most surprisingly, however, there is nothing of this sort in the Fraser series of Walter's plants. The only one of Walter's preserved specimens which matches his description of *E. linearifolium*, "foliis linearibus integris subverticillatis, calycibus 3 ad 5-floris", is no. 671 on page 44. This specimen, with few-leaved axillary fascicles, is a good match for *E. tortifolium* Chapm. in

Bot. Gaz. iii. 5 (1878), with "leaves vertical, lanceolate, entire, . . . , the upper ones linear, alternate; . . . heads . . . 5-flowered; . . . Leaves 1–1½ in. long", Walter's "foliis linearibus . . . subverticillatis" evidently referring to the false whorls produced by the suppressed axillary branches of few leaves which regularly occur in *E. tortifolium*, as shown by isotypic material from Chapman and Ravenel's material from Santee Canal, the home of Thomas Walter. It is evident that the name *E. tortifolium* Chapm. (1878) must give way to E. LINEARIFOLIUM Walt. (1788).

The plant which has erroneously passed as *Eupatorium linearifolium* is

E. HYSSOPIFOLIUM L., var. **calcaratum,** nom. nov., foliis anguste linearibus vel lineari-oblanceolatis integris 0.5–5 mm. latis, laminis primariis 3–6 cm. longis oppositis vel verticillatis verticillis 4–6 foliis, fasciculo axillari densissime breviori.—Var. *linearifolium* sensu Fernald in RHODORA, xliv. 459, 460, pl. 737, fig. 3 (1942), not *E. linearifolium* Walt., basonym. TYPE from dry sands back of beach near Bass River Light, Dennis, Massachusetts, September 2, 1918, *Fernald & Long*, no. 17,448 in Herb. Gray.; isotype in Herb. Phil. Acad.

All others of Walter's new species of *Eupatorium*, in so far as specimens are preserved, seem to have been correctly interpreted. His *E. fusco-rubrum*, no. 733 on p. 46 of the collection, is small *E. purpureum* L. His *E. Marrubium* seems to be missing. *E. foeniculoides* (on p. 45) is represented by a large panicle of *E. capillifolium* (Lam.) Small, based on *Artemisia capillifolia* Lam. (1783); while *E. compositum* (on p. 46) is represented by a characteristic inflorescence. *E. cordatum* seems to be missing but a specimen of *E. incarnatum* is at the lower right hand corner of p. 46. No. 24 on page 44, marked simply "Eupatorium" is *Kuhnia eupatorioides* L. (1762). Another specimen, marked simply *Eupatorium* (at the right on p. 45), is a characteristic summit of *E. serotinum* Michx. (1803); this can not be reconciled with any species defined by Walter.

CHRYSANTHEMUM CAROLINIANUM Walt. Fl. Carol. 204 (1788). The specimen (684) in the Walter Herbarium is an exceptionally good one, the summit of a large flowering plant. It is, happily, what it was supposed to be when it was transferred to *Boltonia* as *B. caroliniana* (Walt.) Fern. in RHODORA, xlii. 487, pl. 642 (1940).

The plant from which the latter plate was made very closely matches Walter's specimen.

CARDUUS SPINOSISSIMUS Walt. Fl. Carol. 194 (1788), our PLATE 1115, FIG. 1, × 2/5, has generally been interpreted as identical with *Cirsium horridulum* Michx. Fl. Bor.-Am. ii. 90 (1803). This identification of the two may have started with Darlington, Fl. Cestr. ed. 2: 438 (1837), Darlington reducing *Cirsium horridulum* to *Carduus* "SPINOSISSIMUS, Walt.?" but giving a detailed description of the former. Even when, in RHODORA, xiii. 239, 240 (1911), Robinson pointed out that the combination *Cirsium spinosissimum* "(Walt.) Scop." was a sad confusion, since Scopoli's combination was really based on the European *Cnicus spinosissimus* L., he made no suggestion that Walter's plant is not *Cirsium horridulum*. The TYPE of Walter's *Carduus spinosissimus* is a whole plant, even includiing the base, but it is not *Cirsium horridulum*. Instead, it is a very characteristic, small specimen of *Cirsium Smallii* Britton in Britt. & Millsp. Baham. Fl. 458 (1920), a renaming of *Cirsium pinetorum* Small, Fl. Miami, 199, 200 (1913), not Greenm. (1905), Small having originally called it *Carduus pinetorum* Small, Fl. Se. U. S. 1308, 1341 (1903). Walter's plant is not only a good match for Florida material sent out by Small; it is almost identical with material collected from "flat pineland" by Ravenel close to Walter's home, in Santee Canal, South Carolina. Owing to the European *Cirsium spinosissimum* (L.) Scop. the name C. SMALLII has right-of-way.

Walter had two other species of *Carduus* and, from the character of the tiny snips which he gave to Fraser, Asa Gray was justified in his manuscript note of February 9, 1839, in writing merely "Carduus = 3 thistles!". He was then unfamiliar, of course, with *Cirsium Smallii*, which was first recognized in 1903, and the two fragments mounted beside that superior specimen were of species then unfamiliar to him. *Carduus virginianus* L. was clearly described by Walter "foliis lanceolatis spinulosis" etc. and he obviously had that species. His third species was *Carduus*

carolinianus 2. foliis amplexicaulibus, hastato-pinnatifidis, spinis inaequalibus ciliatis, subtus tomentosis, calycibus aphyllis, squamis spinulosis, floribus paucis rubris.

In Rhodora, xlv. 509, 510 (1943) the senior author, engaged at that time in a close study of eastern North American *Cirsium*, pointed out the many characters which distinguish *C. flaccidum* (Small) Petrak in Beiheft. Bot. Centralbl. xxxv. Ab. 2: 543 (1917), based on *Carduus flaccidus* Small, Fl. Se. U. S. 1307, 1341 (1903), and *Cirsium virginianum* (L.) Michx. Among the many characters then noted were the following: "In *C. virginianum* the peduncle-like flowering branches have several bracteiform leaves, in *C. flaccidum* the peduncles are naked or with only 1 or 2 bracts; in *C. virginianum* the involucre is 1.5–3 cm. high, in *C. flaccidum* only up to 2 cm. high". The small bit preserved by Fraser (no. 376 on p. 25) is merely a portion of an inflorescence (our plate 1115, fig. 2, × 2/5) but it shows the naked leading peduncle of *C. flaccidum* and the involucre about 1.4 cm. high, a measurement below that shown in *C. virginianum* but duplicated or approximated by heads of many specimens of *C. flaccidum*. Fraser's fragment shows no well developed cauline leaves but numerous well collected specimens of *C. flaccidum*, such as Hall's material (our plate 1115, figs. 3 and 4) from slightly west of Small's type-region, in eastern Texas, well display the "foliis amplexicaulibus hastato-pinnatifidis spinis inaequalibus ciliatis" of *Carduus carolinianus*. They also show the naked leading peduncle as in the fragment preserved in the Fraser volume. It, therefore, seems that we should call the characteristic southern and inland species

Cirsium **carolinianum** (Walt.), comb. nov. *Carduus carolinianus* Walt. Fl. Carol. 195 (1788). *C. flaccidus* Small, Fl. Se. U. S. 1307, 1341 (1903). *Cirsium flaccidum* (Small) Petrak in Beiheft. Bot. Centrabl. xxxv. Ab. 2: 543 (1917); Fernald in Rhodora, xlv. 509 (1943). Our plate 1115, figs. 2 and 3.

Part V. A Few Species of later Authors

Betula excelsa Ait. Hort. Kew. iii. 337 (1789) is, as shown by the very complete type preserved, not an American, although thought by Aiton to be "Nat. of North America", and by various American and European students guessed to be *B. papyrifera* Marsh. There must have been other misconceptions regarding it, these reflected in the specific name and the English "Tall Birch Tree", for the fruiting type shows round-ovate leaves

hardly 3 cm. long and nearly as broad, while the excellent plate of the cultivated *B. excelsa* in Watson, Dendr. Brit. ii. t. 95 (1825) is obviously from a similar source, the tree described by Watson as 12–14 feet high ("70–80 in native country"), the leaves "subcordate-rotund, subincised-dentate", after which Watson gave the "Country . . . Province of Maine, Hudson's River". As what many botanists would delight to call him, a native "Mainiac", the senior author can vouch that nothing like it is known from Maine (nor from "Hudson's River"). Schneider, Ill. Handb. Laubholzk. i. 108 (1904), called it a hybrid of *B. pumila* L. and *B. papyrifera*, a not very convincing identification, while Rehder, Man. Cult. Trees and Shrubs, 142 (1927) said "perhaps a form of *B. pubescens* [European]", a reasonable guess.

FAGUS FERRUGINEA Ait. Hort. Kew. iii. 362 (1789) is characteristic *F. grandifolia* Ehrh., var. *caroliniana* (Loud.) Fern. & Rehd., forma *mollis* Fern. & Rehd. in RHODORA, ix. 114 (1907). Aiton's brief description, "foliis ovato-oblongis remote acute serratis acuminatis subtus tomentosis", indicates pubescence but not the leaf-base. His specimen shows the relatively broad leaves of the fruiting branch rounded to subcordate at base and the involucre with subdistant prickles. Those who consider this a separate species should note that *F. ferruginea* is, apparently, the earliest binomial for it.

CYPRIPEDIUM REGINAE Walt., forma **albolabium**, nom. nov. *C. spectabile* Salisb., β. *album* Sweet, Brit. Flower Garden, iii. t. 240A (1828); *C. Reginae album* Rolfe in Orchid Rev. v. 196 (1897) and xix. 208 (1911); *C. reginae*, forma *album* House in Bull. N. Y. State Mus., nos. 243–244: 37 (1923); not *C. album* Ait. Hort. Kew. iii. 303 (1789), basonym of all three combinations.

When Sweet described the plant with "labello extus albo" he called the one with "labello incarnato" *Cypripedium spectabile* α. *incarnatum*, and in the general synonymy of the two he cited *C. album* of Aiton. While it is possible to argue that Sweet did not mean that his β. *album* was truly *C. album* Ait., nomenclaturally, Aiton's name being there cited, must be considered the basonym. Sweet recognized that his α. *incarnatum* was the plant which had long been cultivated in England and he said of the "beautiful white variety": "We had never before seen or heard of a white variety". It is unfortunate, then, that he picked up

Aiton's misleading name. Rolfe, nearly 80 years later (1897), left no doubt when he wrote: "A most beautiful albino of Cypripedium Reginae, better known as C. spectabile, might recently be seen in the Orchid house at Kew, in which the rose-pink colour had vanished from the lip, leaving it as pure snow-white as the sepals and petals. . . The old specific name of C. album given by Aiton has been superseded by the still older C. Reginae, but can be most appropriately revived for the variety—C. Reginae album."

In describing *Cypripedium album* Aiton said nothing in his description about the lip or its color, although he called the plant "White Lady's Slipper" to contrast with yellow and purple *C. Calceolus* and with *C. acaule*, the latter "flore purpureo"; but he cited Plukenet's figure of the American plant "flore gemello [frequently so in *C. reginae*] candido venis purpureis striato". Since the plate in Bot. Mag. vi. t. 216 (1793), of the plant then being cultivated at Kew and elsewhere in England as *C. album* Ait., shows the roseate lip of ordinary *C. reginae*, we appealed for aid to Mr. Victor Summerhayes, Keeper of Orchids in the Herbarium at Kew. From his very illuminating letter of July 14, 1948 we quote:

We have a copy of an uncommon book by a Miss Margaret Meen entitled "Exotic Plants from the Royal Gardens at Kew", consisting of two parts both published in 1790. This consists of a number of folio coloured plates and plate 3 of part i represents *Cypripedium album*. In this plate the sepals and petals are white but the lip is quite dark reddish with a paler interior.

Taking this plate in conjunction with that in Botanical Magazine, t. 216 and Aiton's own citation of Plukenet's plant, there seems to me little doubt that the plant in general cultivation at that time, including Kew, had a pink or reddish lip and that the albino form, with pure white lip, was not grown until later. I quite agree with you that the name "album" cannot be applied to the white-lipped variety, at any rate not with Aiton's name associated with it.

Most singularly, the brief diagnosis of *Cypripedium reginae* Walt. Fl. Carol. 222 (1778) contains the phrases "caule multifloro, flore albo magno". The specimen in the Fraser series (on p. 39) has two flowers and the lip is obviously darker than the sepals and petals; *i. e.* it was the usual roseate-lipped plant.

LISTERA BANKSIANA Lindl. Gen. & Sp. Orchid. Pl. 455 (1840); our PLATE 1116. The original sheet of this species in herb.

Lindley at Kew, our FIG. 1, × ⅖, contains two collections from Banks Island (on the west coast of British Columbia), collected by Menzies, the material at the right being the TYPE, but with two much better specimens at the left, also from Banks Island, *Menzies*, which are identical. Below the latter specimen has been added "?California Mr Menzies" which is confusing and an assumption not well according with the location of the original Banks Island, an island nearly 50 miles long and lying between latitudes 53 and 54 degrees, opposite Graham Island of the Queen Charlotte group. The specimens are a very close match for *L. caurina* Piper in Erythea, vi. 32 (1898), our FIG. 2, × ⅗, and the latter name should lapse in favor of *L. banksiana* Lindl., based upon "*Ophrys banksiana* Menzies MSS.".

Wiegand, in Bull. Torr. Bot. Cl. xxvi. 157 et seq. (1899), somewhat further complicated matters by assuming that the Banks Island plant is *L. convallarioides* (Sw.) Torr., from which, however, it differs in many characters, most notable being the relative length of bracts and pedicels. Notes made at Kew, where *L. banksiana* was examined, indicate that the bracts were "much shorter than the pedicels". In *L. caurina* the bracts are described as "⅓ the length of the pedicel". In *L. convallarioides*, on the other hand, the bracts and pedicels are equal or with the bracts barely exceeding the pedicels and in *L. Eschscholziana* the pedicels are somewhat exceeded by the bracts. It would seem, therefore, that the identity is between the latter two species rather than that all four are identical. Wiegand believed that Piper's *L. caurina* does not occur in Alaska (to the north of Banks Island), stating that "there is no other species [except *L. convallarioides*] of this section found in Alaska". More recent collecting shows that *L. banksiana* (*L. caurina*) extends northward into southeastern Alaska, considerably to the north of Banks Island.

LISTERA ESCHSCHOLZIANA Cham. in Linnaea iii. 33 (1828); our PLATE 1117, × ½. There has been some question regarding the identity of this plant; Wiegand, l. c. 160, merely inferring from the description that it is *L. convallarioides* (Sw.) Torr.; while Ames, Enum. Orchids U. S. & Can. 75 (1924) made the note: "*Listera Eschscholoziana* Chamisso, which is questionably referred to *L. convallarioides* (Swartz) Nuttall [not a validly made

combination by Nuttall], may be conspecific with *L. caurina* Piper". It is, consequently, worth noting that in the Gray Herbarium there are three plants of the original collection bearing Chamisso's own label. This collection, with the label, is shown in PLATE 1117, FIG. 1, the material also bearing Wiegand's identification as *L. convallarioides* and validation of the latter name by Hultén. Similar material from the herbarium of Jacques Gay is in the Lindley Herbarium at Kew, this marked by Gay "Chamisso misit Jan. 1829". These two specimens better displaying the broad lip are shown in FIG. 2.

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PLATES

CELTIS OCCIDENTALIS L.: FIG. 1, TYPE, × ½.
C. CRASSIFOLIA Lam.: FIG. 2, TYPE, × ½.

CELTIS PROCERA, FOLIIS OVATO-LANCEOLATIS SERRATIS, FRUCTU PULLO of Gronovius, cited by Linnaeus as a secondary element of his C. OCCIDENTALIS: FIG. 1, the Clayton (Gronovian) specimen, × ca. ½.

C. PUMILA Pursh: FIGS. 2 and 3, TYPE, × 5/7, courtesy of Messrs. *Pennell* and *Long*.

Polygala cruciata L.: fig. 1, portion of plant, × 1, from west of Snead's, Jackson Co., Florida, *Wiegand & Manning*, no. 1735; fig. 2, portion of raceme, showing bracts, × 5, from no. 1735; fig. 3, seeds, × 10, from Duval Co., Florida, *Curtiss*, no. 509.

POLYGALA CRUCIATA L., var. AQUILONIA Fernald & Schubert: FIG. 1, portion of TYPE-SHEET, × 1; FIG. 2, portion of raceme, showing bracts, × 5, from Centerville, Massachusetts, September 6, 1896, *E. F. Williams;* FIG. 3, seeds, × 10, from Wellfleet, Massachusetts, *Fernald & Long*, no. 17,037.

HYPERICUM PROLIFICUM L.: FIGS. 1–3, TYPE; FIG. 1, plant, × ½; FIG. 2, portion of description (quoted by Svenson), × ½; FIG. 3, summit of plant, × ⅘.

H. SPATHULATUM (Spach) Steud. = *H. prolificum*, in part, of L. and sensu most authors: FIG. 4, a specimen, × ½, in the Linnaean Herbarium.

RUDBECKIA HIRTA L.: FIGS. 1 and 2, TYPE, × ca. ½.
R. SEROTINA Nutt.: FIG. 3, TYPE OR ISOTYPE, × ⅓; FIG. 4, upper, and FIG. 5, lower surface of leaf, × 10.

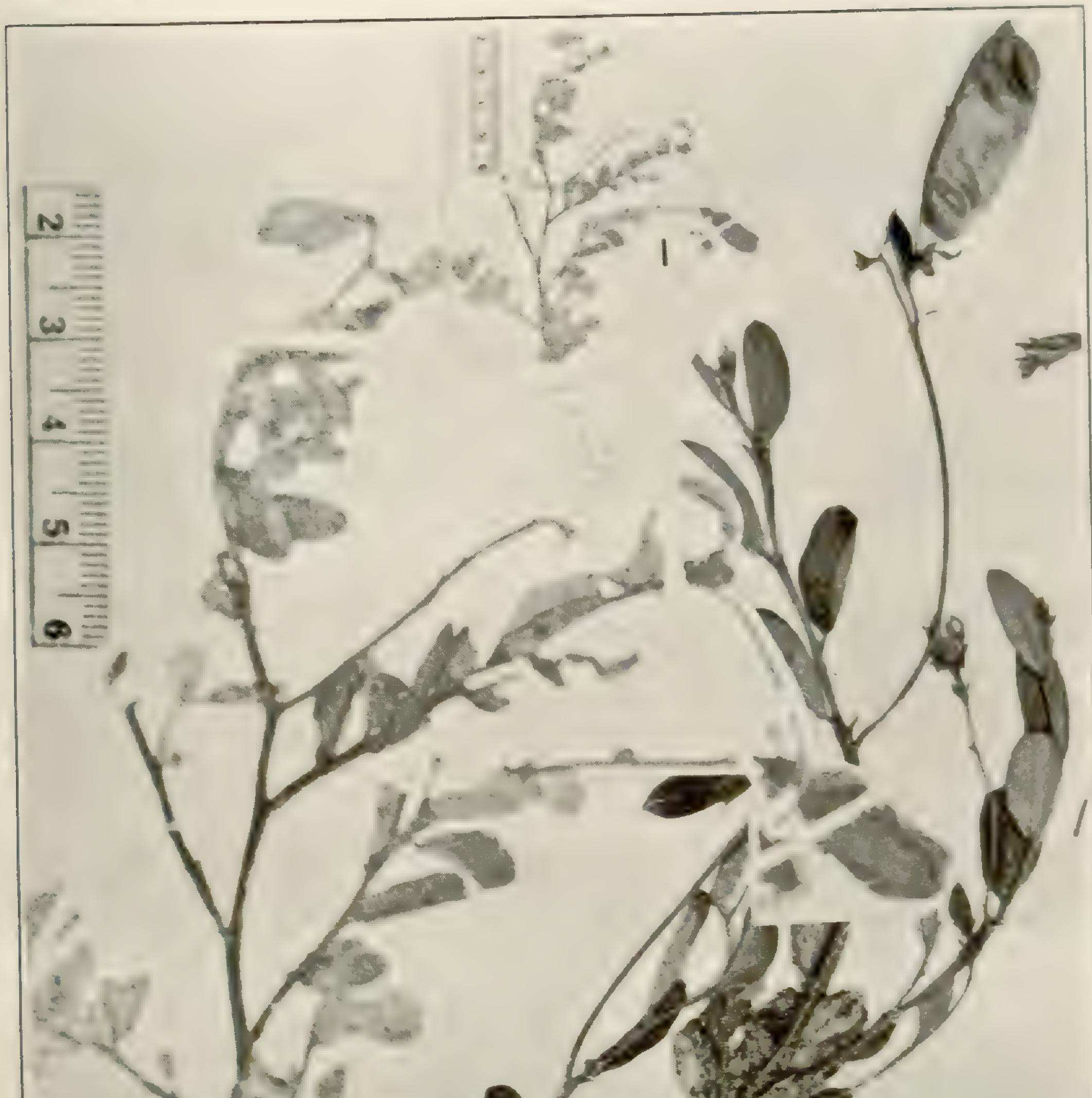
STELLARIA UNIFLORA Walt.; FIG. 1, TYPE, × ½; FIG. 2, portion of TYPE, × 2; FIG. 3, ARENARIA BREVIFOLIA Nutt., plant, × 1, from Pine Mountain, Georgia, *Perry & Myers* in Pl. Exsicc. Gray., no. 546, not *A. uniflora* Luce (1823).

STELLARIA PALUDICOLA Fernald & Schubert: FIG. 1, TYPE, × 1/2, from Myrtle Beach, Horry Co., South Carolina, *Weatherby & Griscom*, no. 16,523; FIG. 2, flower, × 1, from North Carolina, *M. A. Curtis*. Mistakenly supposed to be *S. uniflora* Walt.

CUCUBALUS POLYPETALUS Walt., basis of SILENE POLYPETALA (Walt.) Fernald & Schubert = *S. Baldwynii* Nutt.: FIG. 1, Walter's type, × ½; FIG. 2, *S. Baldwynii:* two inflorescences, × 1, from Aspalaga, Florida, *Chapman.*

SAPONARIA OFFICINALIS L., to which Asa Gray referred the Walter type: FIG. 3, portion of inflorescence, × 1, from Enfield, Massachusetts, July 22, 1931, *Goodale, Potsubay and St. John.*

THERMOPSIS VILLOSA (Walt.) Fernald & Schubert, all figs. × 1½: FIG. 1, TYPE of *Sophora villosa* Walt.; FIGS. 2 and 3, portions of inflorescence of *Thermopsis caroliniana* M. A. Curtis, from mountains of North Carolina, 1842, *Buckley;* FIG. 4, portion of inflorescence of *T. caroliniana* from near Highlands, Macon Co., North Carolina, *Biltmore Herb.*, no. 1332. BAPTISIA CINEREA (Raf.) Fernald & Schubert: FIG. 5, portion of inflorescence, × 1½, from Franklin, Virginia, 1867, *W. M. Canby,* the species erroneously supposed to be ***Thermopsis villosa*** **Walt.**



ANONYMOS (Lupino affinis) ROTUNDIFOLIA Walt. = CROTALARIA ROTUNDIFOLIA (Walt.) Poir., as to basonym only, = *C. maritima* Chapm.: FIG. 1, Walter's TYPE, × ca. ⅓; FIG. 2, the TYPE, × 1; FIG. 3, plant of *C. maritima* Chapm., × 1, from Hillsborough Co., Florida, *Fredholm*, no. 6290.

Impatiens capensis Meerburgh, portion of original plate, × 1 = I. biflora Walt.

HYPERICUM DENTICULATUM Walt., var. TYPICUM = *H. angulosum* Michx. = *Brathys linoides* Spach = *H. virgatum ovalifolium* Britton = *H. denticulatum*, var. *ovalifolium* (Britton) Blake: FIG. 1 (right and left) TYPE of *H. angulosum* Michx. and of *Brathys linoides* Spach, × ½; FIG. 2, portion of a characteristic specimen from Walter's region, east of Andrews, Georgetown Co., South Carolina, *Godfrey & Tryon*, no. 156, × 1.

HYPERICUM DENTICULATUM Walt., var. RECOGNITUM Fernald & Schubert: portion of TYPE, × 1.

HYPERICUM DENTICULATUM Walt., var. ACUTIFOLIUM (Ell.) Blake = *H. virgatum* Lam. = *H. acutifolium* Ell. = *H. Harperi* Keller: FIG. 1, portion of TYPE of *H. virgatum*, × ½; FIG. 2, TYPE of *H. acutifolium*, × ca. ½; FIG. 3, portion of COTYPE of *H. Harperi* × 1.

ORIGANUM FLEXUOSUM Walt. = PYCNANTHEMUM FLEXUOSUM (Walt.) BSP., as to basonym only = *P. hyssopifolium* Benth., both figs. from Walter's TYPE: FIG. 1, TYPE, × ⅖; FIG. 2, inflorescence, × 3.

PINGUICULA CAERULEA Walt.: FIG. 3, TYPE, × ca. ⅓, mislabeled by Fraser as *Utricularia gibba;* FIG. 4, plant and flowers, × 1, from Summerville, South Carolina, *Hunnewell*, no. 8115.

P. LUTEA Walt.; FIG. 2, TYPE, × ½.

OXALIS VIOLACEA L.: FIG. 1, inflorescence, × ½, mislabeled by Fraser as *Pinguicula caerulea!*

EUPATORIUM PILOSUM Walt. = *E. verbenaefolium* Michx. and *E. teucrifolium* Willd., all figs. from Walter's TYPE: FIG. 1, TYPE, × ⅖; FIG. 2, upper leaf, × 2; FIG. 3. portion of inflorescence, × 2.

Carduus spinosissimus Walt.: fig. 1, type, × ⅖ = Cirsium Smallii Britton, not *Cirsium spinosissimum* (L.) Scop.

Carduus carolinianus Walt. = Cirsium carolinianum (Walt.) Fernald & Schubert = *Carduus flaccidus* Small and *Cirsium flaccidum* (Small) Petrak: fig. 2, Walter's type, × $^{2}_{5}$; figs. 3 and 4, portions of a recent specimen from Houston, Texas, *E. Hall*, no. 371, × 1.

LISTERA BANKSIANA Lindl. = *L. caurina* Piper: FIG. 1, TYPE, × $^{2}_{5}$ of *L. banksiana* at right; specimens, × ⅖, from Banks Island, *Menzies*, at left.

L. CAURINA Piper: FIG. 2, inflorescence, × ⅗, from Wreck Bay, west coast of Vancouver Island, *W. R. Carter*, no. 843.

Teste Eric Hultén. 1953

LISTERA ESCHSCHOLZIANA Chamisso = L. CONVALLARIOIDES (SW.) Torr.: FIG. 1, ISOTYPE of *L. Eschscholziana*, × ½, Chamisso in Herb. Gray.; FIGS. 2 and 3, two specimens, × ½, from Chamisso in Herb. J. Gay in the Lindley Herbarium (Kew).

CONTRIBUTIONS FROM THE GRAY HERBARIUM
OF HARVARD UNIVERSITY

No. CLXVIII

A Revision of *Phacelia* Subgenus *Cosmanthus* (Hydrophyllaceae)

By

Lincoln Constance

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A Revision of *Phacelia* Subgenus *Cosmanthus* (Hydrophyllaceae)

By

Lincoln Constance

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A REVISION OF PHACELIA SUBGENUS COSMANTHUS (HYDROPHYLLACEAE)

This paper continues the series of systematic revisions of members of the Hydrophyllaceae begun a decade ago with *Eucrypta* Nutt. (1938), and including *Pholistoma* Lilja (1939), *Ellisia* L. (1940), *Nemophila* Nutt. (1941), and *Hydrophyllum* L. (1942). These taxonomic studies have been supplemented by a steady accumulation of cytological data by Cave and Constance (1942, 1944, 1947), which has now become sufficient to provide information on the chromosome numbers of some of the species in all but a few genera. The family was originally selected for study primarily for reasons of size and propinquity, since the Hydrophyllaceae is a comparatively small group and the greatest number of species occurs in western North America.

The group treated here, however, is unrepresented in the West, and hence appeared a logical choice for investigation during the academic year 1947–1948, which I had the privilege of spending at the Gray Herbarium. The opportunity to observe and collect three of the species in the environs of Washington, D. C., in 1943–1945 had stimulated my interest. Three species were subsequently grown in the greenhouses of the Division of Genetics at Berkeley, in 1946–1947. Through a grant-in-aid from the Permanent Science Fund of the American Academy of Arts and Sciences and the generous sponsorship (arranged by Dr. C. L. Lundell) of Southern Methodist University and the Texas State Research Foundation, I was enabled to do field work in most of eastern Texas during March and April, 1948. This provided an unexcelled opportunity to obtain cytological materials and ample herbarium specimens, as well as to make field observations. In this way, *Phacelia glabra*, *P. hirsuta*, *P. laxa*, *P. patuliflora*, and *P. strictiflora* were studied at first hand. The satisfactory treatment of the last two species had proven difficult from dried material alone, and this excursion provided essential information.

The species included in this revision stand somewhat apart from the others of the genus, and it was anticipated that accumulating evidence might make desirable the bodily removal of *Cosmanthus* from *Phacelia*. Three lines of evidence—morphological, cytological, and distributional—support the conclusion that *Cosmanthus* is not very closely allied to the other groups comprising *Phacelia*. These points are discussed below, but it

may be said here that the alternative of setting up a separate genus has been abandoned or at least deferred in favor of elevating *Cosmanthus* to subgeneric rank but retaining it within *Phacelia*. This disposition would appear to accomplish the objective of indicating that these species have had a development quasi-independent from that of the rest of the genus, without necessitating a host of premature nomenclatorial changes. When the whole of *Phacelia* has been carefully investigated morphologically, cytologically, and distributionally, it may be desirable to reconsider the status here assigned to *Cosmanthus*.

All taxonomists are aware that the old Special-Creationist definition of a species as consisting of a central or normal "species" with or without "aberrant" satellite "varieties" has long been obsolete. This concept has a faint modern echo in the common practice of contrasting the characteristics of varieties with those of "the species" of which they are a part. Actually, of course, a species is a population of diverse individuals which may or may not show distinctive infraspecific morphological-geographical groupings: the modern varieties or subspecies. If a species does show such infraspecific differentiation, one of the resulting groups must necessarily contain the type specimen on which the species was founded. The nomenclature of this type-containing subspecific entity is considerably confused. According to existing provisions of our nomenclatorial code, this entity must bear the first name assigned to it in the proper rank, but it is recommended that the specific epithet be repeated, with or without a prefix, or that one of such customary epithets as "*typicus*, *genuinus*, *originarius*, etc.," be employed in the future for this purpose. In *Phacelia*, Brand has employed the prefix "*eu-*," Voss and Howell have applied the designation "*typica*," and McVaugh has utilized the tautonym. Since the last usage is the only one which has appeared in *Cosmanthus*, I am adopting it here. All of these devices have obvious shortcomings, but it would be a great advantage if the type-containing entity were always mechanically designated in exactly the same manner and if, this designation being uniform and automatic, the author of such a designation could be ignored.

Taxonomic History

The group of species combined here as the subgenus *Cosmanthus* has never been treated as a natural group with exactly the same circumscription. The first species described was doubtfully

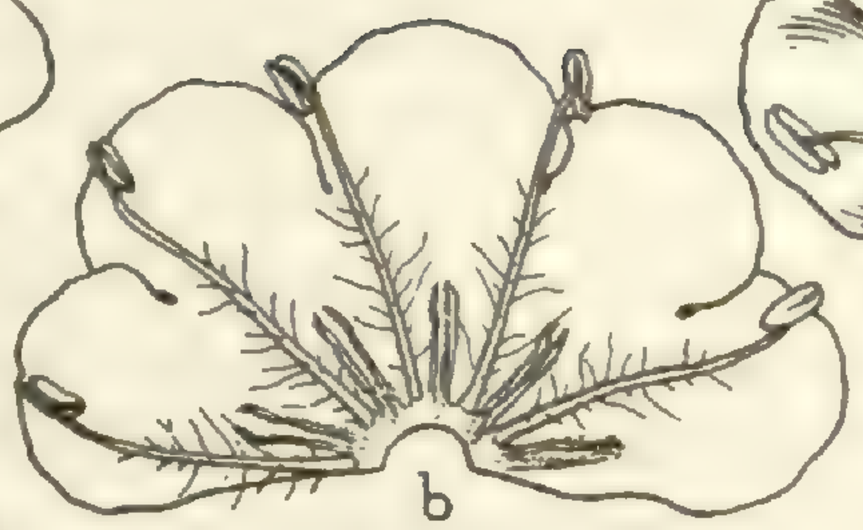
assigned to *Polemonium*, the second to *Convolvulus*, and Michaux was the first to describe any of the species in the correct family and genus. Rafinesque erected the genus *Endiplus* in 1818 for *Phacelia bipinnatifida* Michx. In his "Review of the Order of Hydrophylleae," Bentham (1835) placed two species of this alliance under the genus *Eutoca* and two under *Phacelia*. A. DeCandolle (1845) published the genus *Cosmanthus* Nolte with the sections *Gymnobythus* and *Eucosmanthus*, the latter comprising three of the species treated in the present paper; three other species of the present group were, however, referred to *Phacelia* and two to *Eutoca*. Gray (1875), in his "A Conspectus of the North American Hydrophyllaceae," amplified the genus *Phacelia* by blanketing into it *Eutoca*, *Cosmanthus*, and certain other elements. One of the species under discussion appeared in section *Euphacelia*, two in section *Cosmanthus*, and five species and one variety in section *Cosmanthoides*. Section *Cosmanthus* was separated from section *Cosmanthoides* by the shape and fimbriation of the corolla; Small (1933) used exactly the same criteria to distinguish his two groups, *Fimbriatae* and *Dubiae*, and had also a group *Bipinnatifidae*. Brand (1913) combined all the above species, with the exception of *P. bipinnatifida*, in section *Cosmanthus* of *Phacelia*. This arrangement of the group represents the nearest approach to the treatment adopted in the present paper. A grand total of some forty species has been proposed in this group; fourteen entities are accorded specific rank in this revision.

Special Morphological Characters

Glands. Corolla scales have been given considerable emphasis in classifying Hydrophyllaceae. In *Phacelia*, sections *Gymnobythus* and *Whitlavia* lack scales entirely, but these structures are usually present in sections *Euphacelia*, *Eutoca*, and *Euglypta* (*Microgenetes*). They consist of a pair of structures bracketing the base of each stamen and wholly or partially adnate to the corolla tube by one edge; the other edge may be free or adnate to the base of the filament or the free edge of the opposite scale, and the tip of the scale is often free. *Cosmanthus* completely lacks such scales but has an entirely different organ, which has been confused with them. This consists of a functional or abortive gland or nectary extending distally from the base of the corolla tube on the principal vein which projects into the middle of each corolla lobe. This gland is bordered lengthwise by two parallel flaps, which are adnate to the corolla tube on the

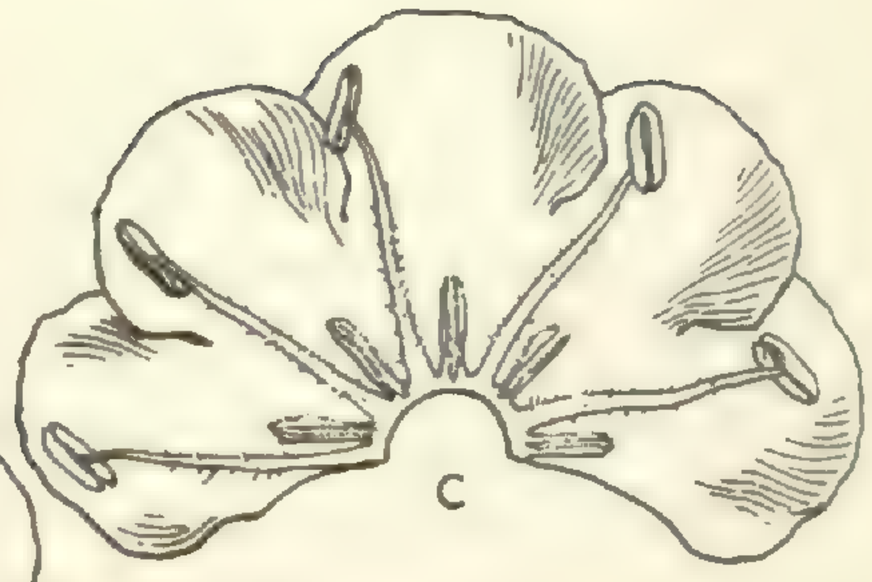
a

P. platycarpa



b

P. pulcherrima

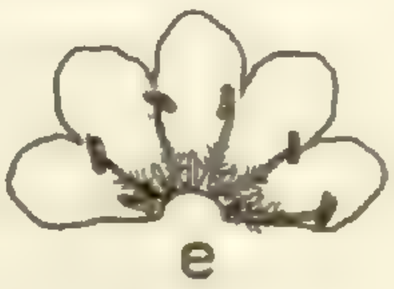


c

P. strictiflora

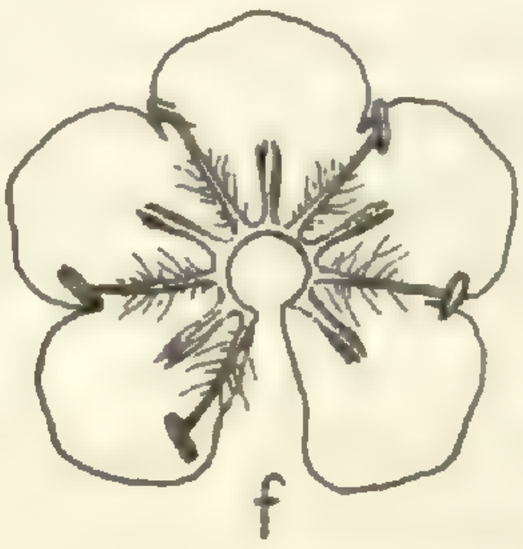
d

P. patuliflora



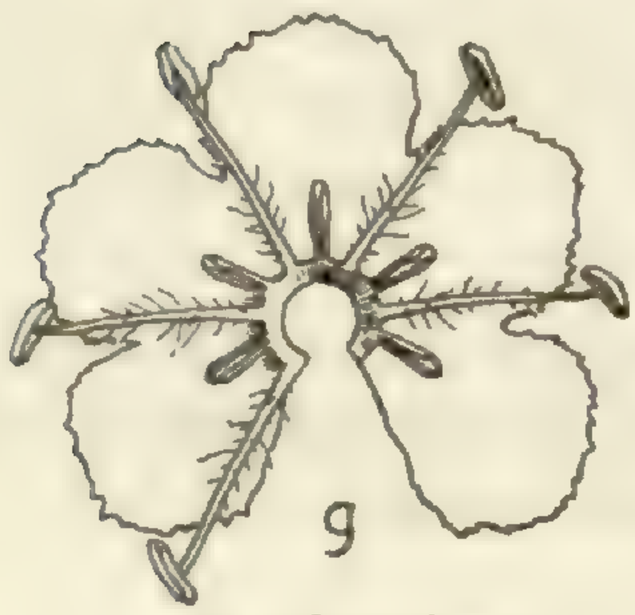
e

P. laxa



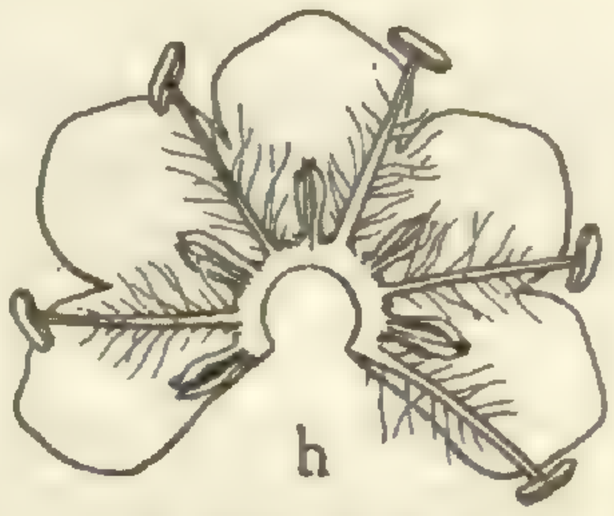
f

P. hirsuta



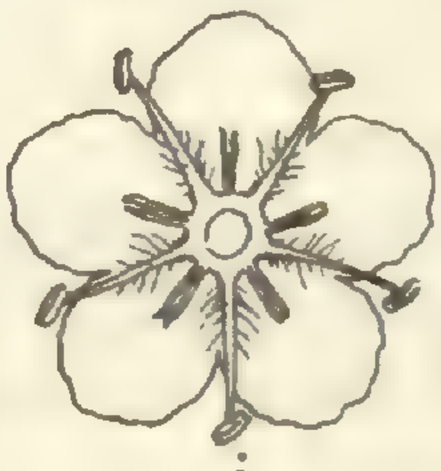
g

P. gilioides



h

P. maculata

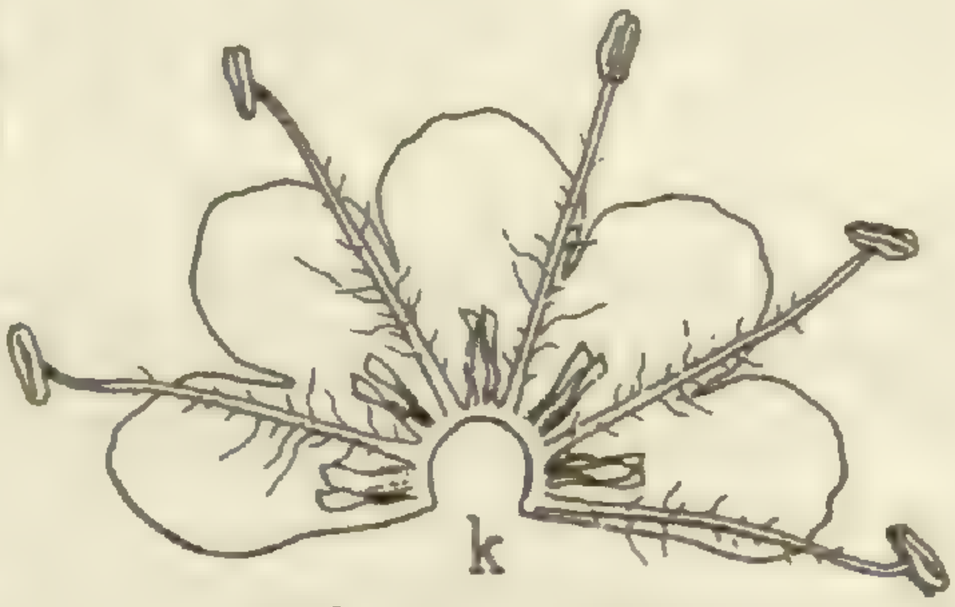


i

P. glabra

j

P. dubia



k

P. bipinnatifolia

l

P. ranunculacea

m

P. Purshii

n

P. fimbriata

Fig. 1. Expanded corollas of *Phacelia* subgen. *Cosmanthus*, all ca. × 1½.

side away from the vein, and free on the side toward the vein. The flaps may be adnate their full length, or the tips may be free (*P. platycarpa* and *P. fimbriata*), and the free edge may be either smooth or puberulent. These flaps appear to be quite distinct from the ordinary corolla scales found in other members of the genus. In *Phacelia bipinnatifida* the glands are apparently functional, being visibly depressed from above, and protruding on the outside. Because of the prominence of the glands and their accompanying flaps, this species has usually been kept out of *Cosmanthus* as possessing "evident corolla scales" but "remote from the stamens." The glands may be vestigial in all other species of *Cosmanthus*, but the parallel flaps are clearly visible in all species, even *P. ranunculacea*. In the last, the position of the aborted glands is indicated only by two minute ridges at the very base of the corolla tube, but in the proper relation to the vein and the filaments. The gland structure is not, so far as I am aware, found elsewhere in *Phacelia*, and is the chief morphological peculiarity of the species here referred to *Cosmanthus*. These glands are illustrated in fig. 1.

PUBESCENCE. The terminology of pubescence is so chaotic that the same conditions are habitually labeled differently by different authors, and the same terms are applied to quite unlike conditions. Some terms relate to the form and size of the individual hairs, others designate their arrangement, and still others denominate their "mass effect"—the product of the nature of the hairs plus their distribution. Terms denoting these different aspects cannot be contrasted successfully with each other, although that attempt is frequently made in keys and descriptions. A complete restudy of pubescence from a cytological and morphological basis, with a redefinition of descriptive terms, is sorely needed. The nature of the pubescence of the stem, peduncles, and pedicels has proven to be very useful in separating entities in *Cosmanthus*. Although the hairs are apparently terete trichomes in all species, in *P. platycarpa*, *P. pulcherrima*, and *P. dubia* they are so weak that they collapse and appear flattened in dried specimens. This is apparently true of the hairs on the stamen filaments in all species which possess them; the absence of stamen hairs in *P. ranunculacea* is a good diagnostic character. The presence or absence of hairs on corolla lobes, styles, and capsules affords distinguishing features between certain species. Four species, *P. pulcherrima*, *P. dubia*, *P. bipinnatifida*, and *P. ranunculacea*, possess stalked capitate glands in addition to the ordinary trichomes at least in the

inflorescence, although these are very small and easily escape detection in *P. dubia* and *P. ranunculacea.* Some plants of *P. patuliflora* var. *patuliflora* also appear to have glands in the inflorescence. The nonglandular pubescence of the vegetative parts is composed of simple tapering trichomes, which are closely appressed or ascending or spreading at right angles. If these hairs are large and rather stiff, the pubescence is spoken of as *hirsute*, if they are smaller and shorter, as *hirsutulous*, and if they are even smaller and finer, as *hirtellous.* When the hairs are closely appressed the condition is described as either *strigose* or *strigulose*, depending upon the size of the hairs. The pedicels in the species with appressed pubescence are often whitened by the abundance of hairs, a condition referred to as *canescent.* All but four of the species in *Cosmanthus* may readily be separated into one of two groups on the basis of the arrangement of hairs on the stem, peduncles, and pedicels. They are appressed in *P. platycarpa* var. *platycarpa, P. patuliflora* var. *teucriifolia, P. gilioides, P. maculata, P. dubia* vars. *dubia* and *georgiana, P. ranunculacea*, and *P. Purshii.* They are spreading in *P. platycarpa* vars. *bursifolia* and *madrensis, P. pulcherrima, P. laxa, P. hirsuta, P. bipinnatifida*, and *P. fimbriata.* These structures are normally hairless in *P. glabra*, but in exceptional specimens a few scattered appressed hairs occur. The two remaining species, *P. strictiflora* and *P. patuliflora*, show a bewildering polymorphism in pubescence, but it seems clear that the former has only appressed or ascending hairs except where it has been "contaminated" by genes from another species.

Ovules and Seeds. The species of *Cosmanthus* may be divided into three groups on the basis of the number of ovules to each placenta, a character which is reflected more or less accurately in the number of seeds borne in mature capsules. Species with 6–14 ovules to each placenta include *P. platycarpa, P. pulcherrima, P. strictiflora*, and *P. patuliflora;* species with usually 4 ovules, *P. laxa, P. hirsuta, P. gilioides, P. maculata, P. dubia* (rarely only 2 ovules); species with uniformly only 2 ovules, *P. bipinnatifida, P. ranunculacea, P. Purshii*, and *P. fimbriata.* There thus appears to be a trend within *Cosmanthus* toward the reduction of ovules to a pair to each placenta. This fact is significant because the sections *Euphacelia* and *Eutoca* of *Phacelia* have been kept apart solely on the basis of the number of ovules, the former having geminate ovules. I have elsewhere indicated doubt that this distinction and these resultant sections are natural. It seems probable that scrapping the old sectional

boundary and pretty completely rearranging the component species, perhaps into several sections, might achieve a considerably more satisfactory classification within the genus. Seed characters are of more value in differentiating these species than had been generally recognized. To emphasize the utility of these characters, photographs of a half-dozen seeds of each species are shown in Plate I. These photographs are the work of Dr. Ian D. Clement, now of the Atkins Garden and Research Laboratory of Harvard University, (Soledad) Cienfuegos, Cuba, to whom I am deeply grateful.

Chromosome Number

Chromosome numbers are now known for all but 3 of the 14 species, as follows:

P. platycarpa var. platycarpa	n = 9	Morley 728, 730, 813; Moore & Wood 3994
P. strictiflora var. strictiflora	n = 9	Constance & Lundell 3243
var. Lundelliana	n = 9	Constance & Cory 3249, 3250
var. connexa	n = 9	Constance 3251, 3252; Constance & Cory 3244; McVaugh 3382
P. patuliflora var. patuliflora	n = 9	Constance & Cory 3247; Constance & Lundell 3217, 3219, 3221, 3231, 3234, 3241, 3247
var. teucriifolia	n = 9	Constance & Cory 3248; Cory 41,473; McVaugh 7709
P. laxa	n = 9	Constance 3223; Constance & Lundell 3214, 3216, 3220
P. hirsuta	n = 9	Constance & Cory 3245; Constance & Lundell 3256, 3257; Demaree; Robbins 2359, 2407
P. maculata	n = 5	McVaugh 8645
P. glabra	n = 8	Constance & Cory 3246; Constance & Lundell 3212, 3255; Robbins 2352
P. dubia var. dubia	n = 5	Constance, Bomhard & Swallen 3019; Constance & McVaugh (Gray Herb. Exsic. 1388)
P. bipinnatifida	n = 9	Duncan 2431, Heiser 2065
P. ranunculacea	n = 14	Constance 3018
P. Purshii	n = 9	Constance 3023; Core; P. R. Stewart

Even with this amount of cytological evidence it is unwise to attempt any far-reaching generalizations, for experience elsewhere in the family has shown that there is no way of knowing what numbers the other entities may reveal. Two or three facts, however, deserve comment. The first is the absence of the number 11, the most common complement throughout the remainder of the genus. The second is that *P. platycarpa*, the

only perennial counted, has 9 pairs; all other perennial species of *Phacelia* have 11, except one which has 10. The cytological evidence, then, reëmphasizes the remoteness of *Cosmanthus* from other species of the genus. The 5 pairs shown by *P. maculata* and *P. dubia* var. *dubia* represent the smallest chromosome number known in the family. The arithmetical possibilities of synthesizing *P. ranunculacea*, with 14 pairs, from *P. maculata* or *P. dubia* and some 9-paired species are very attractive, but it is difficult to see whence one could derive the morphological characteristics that make *P. ranunculacea* so distinctive a plant. Chromosome-number is by no means an infallible taxonomic tool, and in this group the chromosomal data are largely negative. As is so often the case, the differential numbers are confined generally to those species best-marked morphologically; where the morphological distinctions are difficult to ascertain, the chromosome numbers are usually identical! Nevertheless, in dealing with a series of "intergrading" populations, it is reassuring to know that one does *not* have to consider the possibility of polyploidy.

Geographical Distribution

The linear sequence of species in the ensuing taxonomic treatment coincides, very roughly, with a south-to-north trend in distribution. The first two species, the only perennials, are of the Mexican and Guatemalan highlands, the next three are Texan or Oklahoman and, like the following three, perhaps fundamentally Ozarkian, and six are more or less Appalachian. The collective distributions thus suggest a northward migration from Mexico probably quite independent of the route of any of the other groups of *Phacelia*, which now occur to the westward of *Cosmanthus*. Only *P. congesta* Hook. and a few of its relatives appear to overlap the distribution of *Cosmanthus*, and they show no close affinity with it either morphologically or cytologically. Ecologically, the members of *Cosmanthus* appear to be closely associated with the deciduous hardwood forests, where they commonly occur in openings, glades, and forest edges, but human activities have made it possible for some species to spread into secondary habitats. The known distribution of all the species and varieties is represented in a series of outline maps (figs. 2–7).

Acknowledgments

In this study I have been fortunate in having materials, help, and information from many friends, colleagues, and correspond-

ents. Herbarium material has been placed at my disposal by the following institutions; the designating symbols are essentially those recommended by Lanjouw (1938, 1939):

BRU	Brown University
DUKE	Duke University
F	Chicago Natural History Museum
GA	University of Georgia
GH	Gray Herbarium, Harvard University
K	Royal Botanic Gardens, Kew
KSA	Kansas State Agricultural College
KY	University of Kentucky
MEXU	Instituto de Biología, México, D. F.
MO	Missouri Botanical Garden
NY	New York Botanical Garden
OKL	Bebb Herbarium, University of Oklahoma
PA	The Academy of Natural Sciences of Philadelphia
PENN	University of Pennsylvania
SMU	Southern Methodist University
TAES	Tracy Herbarium, Texas Agricultural and Mechanical College
TENN	University of Tennessee
TEX	University of Texas
TULA	Tulane University
UC	University of California
US	Department of Botany, United States National Museum
WVA	West Virginia University

I have also had the privilege of examining specimens in the private herbaria of Dr. E. Lucy Braun, University of Cincinnati; Mr. Ira W. Clokey, whose herbarium is deposited with the University of California; and Mr. Francis W. Hunnewell. I am particularly indebted, however, to my associates at the Gray Herbarium, both staff and students, for their interest, their helpful comments and suggestions, and their patience.

Taxonomic Treatment

Phacelia subgen. **Cosmanthus** (Nolte ex A. DC.), comb. nov.
Cosmanthus Nolte ex A. DC. Prodr. **9:** 296. 1845, as a genus, excluding § *Gymnobythus*.
Phacelia § *Cosmanthus* A. Gray, Proc. Amer. Acad. **10:** 320. 1875.
Phacelia § *Cosmanthoides* A. Gray, op. cit.
Phacelia—Bipinnatifidae Small, Man. SE Fl. 1097. 1933.
Phacelia—Fimbriatae Small, op. cit.
Phacelia—Dubiae Small, op. cit.

Rather low and often delicate perennial, biennial, or annual pubescent or glabrate herbs with alternate, variously toothed to pinnate leaves, and white to lavender or bluish-violet flowers in secund cymes. Corollas semi-rotate to tubular-campanulate, the stamen bases entirely devoid of paired appendages, but a gland, bordered by parallel flaps, on the corolla tube between each pair of stamens. The ovary slightly compressed

laterally, divided into two locules by the intrusion of the two narrow parietal placentae, which are, however, not grown together. Ovules 2–14 to each placenta, the seeds finely reticulate to alveolate and even rugose in some species, but not transversely corrugated. Basic chromosome number apparently n = 9.

Species 14, from the highlands of Guatemala and Mexico north and east into the eastern half of the United States, primarily by way of the Appalachian and Ozarkian mountain systems.

Key to the Species

A. Corolla lobes minutely crenulate to entire; corolla tubular-campanulate to rotate-campanulate.
  B. Corolla broadly campanulate to rotate-campanulate; stamens 3–10 mm. long; style 3–15 mm. long; capsule slightly compressed, not distended; seeds ovoid-angled.
    C. Branches and pedicels and the summit of the ovary variously and conspicuously hairy.
      D. Inflorescence variously pubescent, but not glandular.
        E. Pubescence of conspicuously flattened hairs; distal ends of the appendages free; Mexican or Guatemalan perennial.....1. *P. platycarpa.*
        EE. Pubescence of terete hairs; distal ends of the appendages adnate to the corolla; annual.
          F. Basal leaves conspicuously rosulate, shallowly toothed or lobed; fruiting pedicels usually strictly erect, short in comparison with the calyx.....3. *P. strictiflora.*
          FF. Basal leaves not conspicuously rosulate, pinnate or pinnatifid; fruiting pedicels spreading-ascending to reflexed, slender.
            G. Pubescence of the stems, peduncles, and pedicels spreading; calyx lobes spreading in anthesis.
              H. Cauline leaves all or nearly all petiolate; pubescence sparse.....5. *P. laxa.*
              HH. At least the upper cauline leaves sessile; pubescence dense.
                I. Cauline leaves dentate or shallowly lobed; ovules 6–12 to each placenta; seeds usually 10–15.....4. *P. patuliflora.*
                II. Cauline leaves deeply lobed to pinnatifid; ovules usually 4 to each placenta; seeds 6–8.....6. *P. hirsuta.*
            GG. Pubescence of the stems, peduncles, and pedicels closely appressed; calyx lobes erect or ascending in anthesis.
              J. Cauline leaves dentate or shallowly lobed; ovules 6–12 to each placenta.....4. *P. patuliflora.*
              JJ. Cauline leaves deeply lobed or pinnatifid; ovules usually 4 to each placenta.
                K. Lobes of the cauline leaves linear-lanceolate to oblong, usually acute; corolla lobes denticulate to fimbriate.....7. *P. gilioides.*
                KK. Lobes of the cauline leaves oblong to oblong-obovate, obtuse; corolla lobes minutely crenulate.....8. *P. maculata.*

DD. Inflorescence beset with stalked capitate glands. (See also no. 4.)
L. Cauline leaves all petiolate; corolla 10–15 mm. broad; pedicels recurved or pendent in fruit; seeds 2.5–4 mm. long, black, areolate and finely alveolate.
M. Calyx lobes ovate-lanceolate to ovate, 5–6 mm. broad; capsule 10–12 mm. in diameter; ovules 8–10 to each placenta.....2. *P. pulcherrima.*
MM. Calyx lobes linear, 0.5–1.5 mm. broad; capsule 4–6 mm. in diameter; ovules 2 to each placenta.....11. *P. bipinnatifida.*
LL. Upper cauline leaves sessile; corolla 5–10 cm. broad; pedicels spreading-ascending to spreading in fruit; seeds 1.5–1.75 mm. long, brown, finely reticulate.....10. *P. dubia.*
CC. Branches and pedicels and the summit of the ovary glabrous (or with a very few stiff hairs).....9. *P. glabra.*
BB. Corolla tubular-campanulate; stamens 1.5–2 mm. long; style 1.5–2 mm. long; capsule markedly distended by the globose-ovoid seeds.....12. *P. ranunculacea.*
AA. Corolla lobes fimbriate or coarsely denticulate; corolla subrotate.
N. Corolla lobes conspicuously pilose on the back; ovules usually 4 to each placenta.....7. *P. gilioides.*
NN. Corolla lobes glabrous or glabrate; ovules 2 to each placenta.
O. Pubescence of stems and inflorescence closely appressed; lobes of cauline leaves mostly acute; corolla bluish-lavender; seeds 1.5–3 mm. long, areolate and finely alveolate.....13. *P. Purshii.*
OO. Pubescence of stems and inflorescence spreading; lobes of cauline leaves mostly obtuse; corolla white, rarely lavender-tinged; seeds 3–3.5 mm. long, finely reticulate.....14. *P. fimbriata.*

1. **Phacelia platycarpa** (Cav.) Spreng. Syst. **1:** 584. 1825.
Convolvulus platycarpos Cav. Icon. **5:** 155, *pl. 482.* 1799.
Polemonium pimpinelloides Willd. ex Roem. & Schult. Syst. **4:** 793. 1819.
Polemonium achilleaefolium Willd. ex Roem. & Schult. Syst. **4:** 793. 1819.
Eutoca pimpinelloides Spreng. Syst. **1:** 569. 1825.
Eutoca mexicana Benth. Trans. Linn. Soc. **17:** 277. 1834.
Eutoca Andrieuxii A. DC. Prodr. **9:** 294. 1845.
Cosmanthus mexicanus A. DC. Prodr. **9:** 297. 1845.
Eutoca gracilis Mart. & Galeotti, Bull. Acad. Brux. **12²:** 276. 1845.
Eutoca Ortgiesiana Heer ex Regel, Gartenfl. **10:** 309, *pl. 337.* 1861.
Nemophila Ortgiesiana Roezl ex Regel, loc. cit. (Nomen.)
Phacelia pimpinelloides A. Gray, Proc. Amer. Acad. **10:** 321. 1875.
Phacelia pubescens Peter, E. & P. Pflanzenfam. **4³ᵃ:** 64. 1893, non Poir. 1804.
Phacelia patuliflora var. *mexicana* Brand; Engler, Pflanzenr. **4²⁵¹:** 66. 1913.

Perennial from a stout taproot, 5–40 cm. high, branching from the base, the branches prostrate to spreading-ascending; stems and inflorescence pubescent with conspicuously flattened hairs; basal leaves densely rosulate, petiolate, linear to oblanceolate or oblong, 3–15 cm. long, 0.8–6 cm. broad, pinnate with 4–8 pairs of oblong to obovate, entire to pinnatifid,

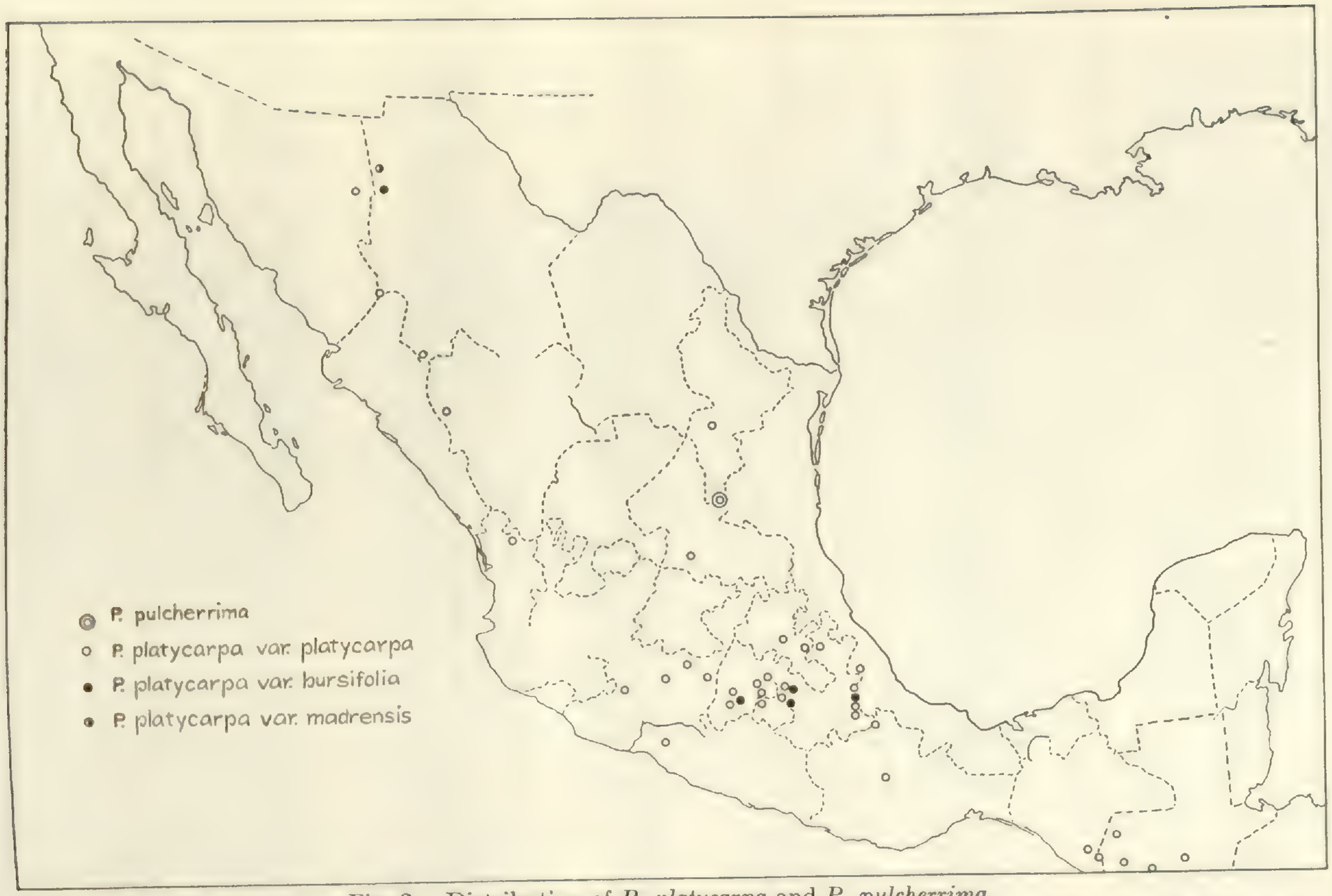


Fig. 2. Distribution of *P. platycarpa* and *P. pulcherrima*.
(Based on Goode's Series of Base Maps, map No. 112. Copyright by the University of Chicago. Used by permission)

distinct leaflets, or the terminal confluent, the cauline leaves usually petiolate, like the basal but reduced upwards, pinnate to merely toothed, strigulose to hirsute on both surfaces; inflorescence of simple or paired terminal 6–25-flowered cymes, the mature pedicels spreading-ascending to spreading-reflexed, 5–30 mm. long; calyx lobes linear-lanceolate to ovate-lanceolate, 3–6 mm. long, 1–2.5 mm. broad, usually unequal, acute or acutish, hairy; corolla pinkish-lavender to pale blue or white with rose-colored veins, rotate-campanulate, 7–15 mm. broad, the lobes oval to orbicular, entire, pilose on the back; gland flaps free at the tip, puberulent; stamens about as long as the corolla, 4–6 mm. long, the anthers oblong, 0.8–1.2 mm. long, the filaments villous on their lower ½; style included in flower, when mature 3–6 mm. long, cleft about ⅔, hirsutulous below the middle, the summit of the ovary hirsute; mature capsule globose, 4–6 mm. in diameter; ovules 8–10 to each placenta; seeds 9–15, ovoid-angled, 1.5–3 mm. long, brown, areolate and finely alveolate.

Pubescence of the pedicels and peduncles appressed, the inflorescence canescent.....a. var. *platycarpa*.
Pubescence of the pedicels and peduncles spreading, the inflorescence villous-hirsute.
Leaflets crowded, mostly entire; pubescence shaggy-villous .....b. var. *bursifolia*.
Leaflets rather remote, toothed or lobed; pubescence short-villous.....c. var. *madrensis*.

1a. **Phacelia platycarpa** var. **platycarpa**

TYPE LOCALITY: "Habitat iuxta Chalma oppidum mexicanum," *Cavanilles*.

DISTRIBUTION: Nuevo León to Sonora, throughout montane Mexico to Guatemala, at elevations of 6,000–15,000 feet.

REPRESENTATIVE SPECIMENS: **MEXICO.** NUEVO LEÓN. Cerro Potosí, *Mueller 2246* (F, GH), *Schneider 937* (F, GH, MO, UC). CHIHUAHUA. Mt. Mohinora, *Nelson 4842* (GH, US); Colonia Garcia, *Nelson 6056* (GH, US); Mesa de Baseachic, *LeSueur 868* (F, TEX). SONORA. Rancho de Cruz Díaz, *S. S. White 2279* (GH). DURANGO. ————, *Garcia 388* (US). SAN LUIS POTOSÍ. San Luis Potosí, *Parry & Palmer 606* (GH, K, MO, PA, US). NAYARIT. Santa Teresa, *Rose 2164* (F, GH, K, US). JALISCO. Ferreria, 1892, *M. E. Jones 112* (MO, US). VERA CRUZ. Orizaba, *Seaton 409* (F, GH, NY—part, US), *Liebmann 15,241* (F, GH, US), *Galeotti 3079* (K: isotype of *Eutoca gracilis* Mart. & Galeotti). HIDALGO. El Chico, 1929, *Lyonnet 338* (GH, MO, NY, US); Sierra de Pachuca, *Pringle 7583* (F, MO). MÉXICO. Monte de Rio Frio, *Mexia 2680* (F, GH, MO, NY, PA, UC, US); 33 miles E. of Mexico City, *Hitchcock & Stanford 7021* (GH, MO, NY, UC); Mexico City—Oaxaca, *Karwinski* (type collection of *P. pubescens* Peter, F & GH: photos); La Gavia, *Sharp 44,288* (TENN, UC); Amecameca–Popocatepetl, *Moore* (GH, UC). D. F. Eslava, *Pringle 9374* (GH, NY, US). MORELOS. Tres Marias, *Pringle 13,122* (F, GH, US). MICHOACÁN. "mines of Tlalpuxahua," 1830, *Graham 253* (K: type of *Eutoca mexicana* Benth.); Pátzcuaro,

Pringle 4165 (F, GH, MEXU, MO, NY, PA, UC, US); Tancitaro, *Leavenworth 265* (F, GH, MO, NY); Zitácuaro–Zirahuato, *Hinton 11,961* (F, GH, MO, NY, TEX, US); Zitácuaro, *Hinton 11,862* (F, GH, MO, NY, TEX, US). GUERRERO. Limon Mt., *Rusby 359* (US). PUEBLA. Huauchinango, 22 April 1893, *Salazar* (MEXU, US). OAXACA. Cerro San Felipe, *Nelson 1048* (US), *1083* (US), *Andrieux 217* (K: isotype of *Eutoca Andrieuxii* DC., F: photo). CHIAPAS. Ventana, *Matuda 4553* (GH, MO, NY); Mt. Male, *Matuda 4611* (GH, MO, NY). **GUATEMALA.** HUEHUETENANGO. Chémal, *Standley 81,135* (F), *50,312* (F); Chiantla, *Standley 65,591* (F). CHIMALTENANGO. Santa Elena, *Skutch 451* (US), *Standley 58,676* (F), *61,004* (F). QUEZALTENANGO. Volcán de Santa Maria, *Standley 67,519* (F); Volcán Zunil, *Steyermark 34,639* (F); Palestina, *Standley 84,302* (F). SOLOLÁ. Volcán Santa Clara—town, *Steyermark 47,139* (F).

The type material of *Convolvulus platycarpos* Cav. ("habitat iuxta Chalma oppidum mexicanum") and *Eutoca Ortgiesiana* Heer ("in einer Sendung mexikanische Sämereien") have been figured, and I have seen types or isotypes of *Eutoca mexicana* Benth. ("in the neighbourhood of the mines of Tlalpuxahua, and between that place and the city of Mexico"), *E. Andrieuxii* A. DC. ("in editioribus montis Mexicana San Felipe locis humidis"), and *E. gracilis* Mart. & Galeotti ("au bord des ruisseaux du pic d'Orizaba, de 9,500 á 12,000 pieds"). The type of *Phacelia pubescens* Peter ("Guatemala, Mexico") is Negative no. 20,280 of the Field Museum series. There is no question that all of these names are applicable to *P. platycarpa* var. *platycarpa* as interpreted here. *Polemonium pimpinelloides* Willd. and *P. achilleaefolium* (both "in Mexico") were treated by Gray as synonyms of this entity, and there is no evidence available to dispute that reference. I have seen none of the three collections cited by Brand as the basis of his *Phacelia patuliflora* var. *mexicana*, and the description is decidedly anomalous. From the distribution cited (Jalisco, Hidalgo, and México), however, there seems to be little doubt that the entity should be referred here.

Despite its broad range and great variability, there appears to be little or no regional differentiation in this population. Seeds planted in the late autumn of 1946 germinated and grew profusely in a lath house in Berkeley in the late spring and summer of 1947. In these, the flowers were white with maroon veining, but from the descriptions, the species must vary widely in flower color.

1b. **Phacelia platycarpa** var. **bursifolia** (Willd.), comb. nov.
Polemonium bursifolium Willd. ex Roem. & Schult. Syst. **4:** 793. 1819.
Eutoca bursifolia Spreng. Syst. **1:** 569. 1825.

Eutoca acaulis Mart. & Galeotti, Bull. Acad. Brux. **12**[2]**:** 276. 1845.
Polemonium acaule Schiede ex Mart. & Galeotti, op. cit. 277. (Nomen.)
Phacelia rupicola Rob. & Fern. Proc. Amer. Acad. **30:** 119. 1894.
Phacelia acaulis Brand; Engler, Pflanzenr. **4**[251]**:** 67. 1913.

Acaulescent or nearly so, 5–15 cm. high, shaggy-villous throughout with soft spreading flattened hairs up to 3 or 4 mm. long; leaves pinnate or pinnatifid, the leaflets or lobes crowded, entire or with one or two teeth near the tip.

TYPE LOCALITY: "In Mexico," *Humboldt & Bonpland.*

DISTRIBUTION: High mountains, Strawberry Valley (Chihuahua) to Orizaba, Popocatepetl, Ixtaccihuatl, and Toluca (Vera Cruz and México) at or near timberline (10,000–14,500 feet).

REPRESENTATIVE SPECIMENS: **MEXICO.** CHIHUAHUA. Strawberry Valley, *Hartman 686* (GH: type of *P. rupicola* Rob. & Fern., F, NY, UC, US). VERA CRUZ. Orizaba, *Rose & Hay 5776* (US), March 1908, *Purpus* (UC), *Nelson 288* (US). MÉXICO. Ixtaccihuatl, *Purpus 193* (MO—part, UC—part, US—part), *Heilprin & Baker* (PA); Popecatepetl, *Barkley, Rowell & Webster 2340* (TEX, UC); Toluca, *Hinton 432* (K, US), *Karwinski* (F & GH: photos).

Notable principally for its shaggy-villous pubescence, this evidently overlaps *P. platycarpa* var. *platycarpa* altitudinally, since the two have been mixed in the same collection, notably by Purpus. The type of only *P. rupicola* ("on cliffs in a pine forest of Strawberry Valley, Chihuahua") has been seen, but specimens at the University of California have been annotated as *P. acaulis* ("Dans les endroits humides du pic d'Orizaba, à 12,800 pieds") by Brand. The distributional pattern is remarkable, but I am unable to detect any significant morphological differences between the Chihuahuan and the central Mexican plants.

1c. **Phacelia platycarpa** var. **madrensis** (Greenm.), comb. nov.
Phacelia madrensis Greenm. Proc. Amer. Acad. **39:** 85. 1903.
Phacelia rupicola var. *madrensis* Brand; Engler, Pflanzenr. **4**[251]**:** 67. 1913.

Acaulescent, 20–30 cm. high, short-villous throughout with soft spreading flattened hairs up to 1 or 2 mm. long; leaves pinnate, at least below, the lobes and leaflets rather remote, coarsely toothed or lobed.

TYPE LOCALITY: Sierra Madre, near Colonia Garcia, Chihuahua, *Townsend & Barber 100* (GH: type, F, MO). Known only from this collection.

As stated by Greenman, this differs from the typical phase of the species by "the spreading not appressed pubescence," and from var. *bursifolia* by "the foliar characters" and "the shorter pubescence." The supposed characters in calyx and glands apparently are not important. This is an anomalous entity,

and its retention in varietal status indicates doubt as to its proper disposition until more material has been collected. Both this and the preceding variety, however, agree in the great majority of their characters with var. *platycarpa*, and it is believed that the joining of the three into a single species best indicates their relationship.

2. **P. pulcherrima,** sp. nov.

Herba perennis (?), 6–12 dm. alta, ramosa, ramosis adscendentibus, caulibus hirsutulis, pilis complanatis patentibus; inflorescentia patenti-hirsutula glanduloso-villosaque; folia strigosa ad strigulosa glanduloso-villosaque, basalia vel caulina inferiora petiolata, oblongo-ovala, 9–15 cm. longa, 6–8 cm. lata, pinnata, foliolis 2 vel 4, obovatis, brevis dentatis, distinctis, basi rotundati-cuneatis, terminale magnissimum, basi cordatum 3- vel 5-lobum, folia superiora petiolata, obovata, usque trilobata; inflorescentia scorpoidea, cymis terminalibus solitariis vel geminatis, 10–20-floris; pedicelli maturi recurvati vel declinati, 10–20 mm. longi; calycis lobae ovato-lanceolatae ovataeve, 10–16 mm. longae, 5–6 mm. latae, subaequali, acutae, hirsutulae vel hirsutae glanduloso-villosaeque; corolla violacea rotato-campanulata 10–15 mm. lata, lobis orbicularis integris glabris; appendiculae omnino adnatae; stamina circa 10 mm. longa corolla vix longiora, antheris 1.5 mm. longis, filamentis sub medium villosis; stylus anthesus corolla subequalus, maturus 10–12 mm. longus, ad ⅓ partitus, basi hirtulosus, ovario apice hirsuto; capsula matura globosa 10–12 mm. lata; ovula 8–10 ad quamque placentam; semina circa 12–16 irregulari-ovoidea, 2.5–3 mm. longa, nigra, areolata minutissime alveolataque.

TYPE LOCALITY: On mountains near Miquihuana, altitude, 7,000–9,000 feet, Tamaulipas, Mexico, 10 June 1898, *E. W. Nelson 4495* (type: US 1492795; US 332531, GH). Known only from this collection.

Despite the fact that it has been collected but once, a half-century ago, and that the specimens are incomplete, this is a strikingly distinct species. Its relationship is undoubtedly with *P. platycarpa*, but its glandular pubescence and the remarkable size of all its parts make it sharply distinct.

3. **Phacelia strictiflora** (Engelm. & Gray) A. Gray, Proc. Amer. Acad. **10:** 321. 1875.

Eutoca strictiflora Engelm. & Gray, Boston Jour. Nat. Hist. **5:** 45. 1845.

Annual, 5–30 cm. high, simple and erect or branching at base and the branches erect or somewhat decumbent at base; stems hirsutulous to densely hirsute, the inflorescence canescent to loosely hirsute; basal leaves rosulate, petiolate, cuneate (occasionally truncate) at base, narrowly oblong or oblanceolate to oval, 1–6 cm. long, 0.5–3 cm. broad, toothed or shallowly lobed to deeply pinnately lobed with 1–6 pairs of obtuse or acute teeth or lobes, sparsely hirsutulous on the margins and upper

surface, the lower surface glabrate, to densely strigose on both surfaces; cauline leaves sessile, orbicular to linear-oblong, shallowly dentate to deeply pinnately lobed with 2–6 pairs of obtuse or acute teeth or lobes; inflorescence of simple terminal 3–20-flowered cymes, the mature pedicels strictly ascending (to somewhat spreading), 2–10 mm. long; calyx lobes linear to oblanceolate, 5–15 mm. long, 0.5–4 mm. broad, obtuse or acute, subequal pubescent, the calyces of the lower flowers often markedly accrescent; corolla purplish-lavender, rotate-campanulate, 8–20 mm. broad, the lobes obovate, finely crenulate, pilose on the back; gland flaps wholly adnate, puberulent; stamens included, 5–7 mm. long, the anthers oblong, 1.5–2 mm. long, the filaments villous on their lower ⅔; style included in flower, when mature 5–12 mm. long, cleft about ½, hirsutulous on the lower ½ or ⅔, the summit of the ovary densely hirsute; mature capsule globose-ovoid, 3–6 mm. in diameter; ovules 8–14 to each placenta; seeds 10–20, ovoid-angled, ca. 2 mm. long, black, areolate and finely alveolate.

Foliage dull, not succulent; basal rosette usually early-withering, the basal leaves hirsutulous or hirsute beneath, lobed or divided; cauline leaves narrower, lobed to nearly pinnatifid; lower calyces about equaling those above in fruit.
- Stems spreading-hirsute, the inflorescence loosely hirsute; calyx lobes ovate-lanceolate to ovate ..... a. var. *strictiflora.*
- Stems strigulose, the inflorescence canescent; calyx lobes linear-lanceolate to linear.
  - Branches stout; cauline leaves crowded, linear-oblong, deeply saliently lobed, the lobes acute ..... b. var. *connexa.*
  - Branches slender; cauline leaves rather remote, oval-oblong, nearly pinnatifid, the lobes usually obtuse . c. var. *Robbinsii.*

Foliage bright green, slightly succulent; basal rosette persistent, the basal leaves glabrate beneath, shallowly toothed; cauline leaves broad, shallowly toothed; lower calyces markedly accrescent in fruit ..... d. var. *Lundelliana.*

3a. **Phacelia strictiflora** var. **strictiflora**

TYPE LOCALITY: "Shady soil on the banks of the Brazos near San Felipe, Texas," 1843, *Lindheimer II-279.*

DISTRIBUTION: Central eastern Texas, in sandy soil of fallow fields and on the borders of deciduous woods.

REPRESENTATIVE SPECIMENS: **TEXAS.** "Texas," *Drummond III-298* (GH, NY, PA). Milam Co.: Milano, *Palmer 11,681* (MO, UC). Brazos Co.: Wellborn, *D. C. Bain 126* (TENN). Waller Co.: Hempstead, *J. E. Brodie* 43 (US). Austin Co.: San Felipe, *Lindheimer II-279* (GH: type of *Eutoca strictiflora* Engelm. & Gray, MO, NY, PA). Lee Co.: Lincoln, *Constance & Lundell 3243.* Bastrop Co.: Bastrop, *Tharp 5647* (TEX, US), *M. J. Land* (CLOKEY, GH). Travis Co.: Austin, *Hall 472* (F, GH, MO, NY, US). Gonzales Co.: Ottine Swamp, *Cory 18,178* (GH, TAES).

3b. **Phacelia strictiflora** var. **connexa,** var. nov.

A var. *strictiflora* differt: caulibus adpresse ascendenterque hirsutulis,

inflorescentiis canescentibus, foliis lineari-oblongis, lobis angustioribus gracilioribus et plerumque acutis, lobis calycis linearibus.

TYPE LOCALITY: Sandy soil of roadsides, fallow fields, and openings in oak woods, 5 miles NW of Grapevine, Tarrant County, Texas, 14 April 1948, *Constance 3252* (UC: type).

DISTRIBUTION: Northeastern Texas and adjacent Oklahoma, in sandy soil, especially of fallow fields.

REPRESENTATIVE SPECIMENS: **OKLAHOMA.** Muskogee Co.: Agency Hill, *Bebb 3095* (OKL-part). Cleveland Co.: E of Noble, 4 May 1935, *S. S. Goodman* (GH, OKL, NY). Bryan Co.: Brown, *Mrs. W. L. Ducker 39* (OKL). **TEXAS.** Grayson Co.: Denison, *Constance & Lundell 3254.* Wise Co.: Denton–Decatur road, *Lundell & Lundell 8455* (GH, SMU). Dallas Co.: Dallas, *Reverchon* (*Curtiss 2131*) (F, GH, MO, NY, PA, US), *Bush 637* (GH, MO, NY, US); Carrolton, *Constance 3251.* Tarrant Co.: Lake Worth, *O. L. Killian 6798* (NY, TEX, US). Van Zandt Co.: Grand Saline, 13 March, *M. J. Land* (NY, TEX). Henderson Co.: Athens, *McVaugh 8382* (UC). Anderson Co.: 17 miles SE Athens, *Lundell & Lundell 11,114* (SMU, UC). Limestone Co.: Fort Parker, *Constance & Cory 3244.* Houston Co.: Grapeland, *Palmer 13,195* (MO, US). Bell Co.: Lake Polk, *Wolff 2779* (US). Harris Co.: Hockley, 1889, *Thurow* (US).

3c. **Phacelia strictiflora** var. **Robbinsii,** var. nov.

A var. *strictiflora* differt: caulibus et pedicellis gracilioribus, caulibus adpresse hirsutulis, inflorescentiis canescentibus, foliis subpinnatifidis, lobis calycis linearibus vel lineari-lanceolatis.

TYPE LOCALITY: Open, grazed pasture 10 miles north of Tishomingo near Wapanucka road junction, Johnston County, Oklahoma, 29 May 1948, *G. T. Robbins 3063* (UC: type).

DISTRIBUTION: Western Alabama and Mississippi to eastern Oklahoma and adjacent Texas.

REPRESENTATIVE SPECIMENS: **ALABAMA.** Greene Co.: Miller, *Clausen & Clausen 5724* (CLOKEY, NY). **MISSISSIPPI.** Lowndes Co.: Columbus, *Spillman* (GH, NY). **OKLAHOMA.** Mayes Co.: Pryor Creek, *Bebb 2720* (OKL). Creek Co.: Sapulpa, April 1924, *C. B. Williams* (PA). Muskogee Co.: ————, *Bebb 5090* (GH, OKL); Muskogee, *Carleton 52* (KSA, US). Haskell Co.: Stigler, 12 April 1908, *Brainerd* (GH). Pittsburg Co.: ————, May 1935, *J. E. McClary* (OKL-part). Johnston Co.: Tishomingo, *Robbins 3027* (UC). McCurtain Co.: Beaver Bend State Park, 6 April 1941, *H. R. Griffith* (OKL). Choctaw Co.: ————, *Leavenworth* (NY, PA). Atoka Co.: Limestone Gap, 23 April 1877, *Butler* (GH, MO, PA, US). **TEXAS.** Grayson Co.: Denison, 27 April 1931, *K. Waltz* (TEX), 7 April 1896, *T. V. Momson* (US).

3d. **Phacelia strictiflora** var. **Lundelliana,** var. nov.

A var. *strictiflora* differt: foliis clare viridibus, succulentis, sparsim hirsutulis glabratisque, rosulis basalibus persistentibus, foliis leviter dentatis, caulibus adpresse hirsutulis, calycibus inferioribus in fructu valde auctis, lobis plerumque obtusis, corollis purpurei-coeruleis.

TYPE LOCALITY: Sandy soil of fallow field, 3 miles NNW of the center of Abilene, Taylor County, Texas, 12 April 1948, *Constance & Cory 3249* (US: type).

DISTRIBUTION: Western Oklahoma and northern "West" Texas, in sandy soils.

REPRESENTATIVE SPECIMENS: **OKLAHOMA.** Blaine Co.: Geary, 26 April 1937, *J. Englemann* (OKL). Oklahoma Co.: Spencer, *Waterfall 1954* (OKL). Canadian Co.: Devil's Canyon, *Hopkins 1404* (OKL). Caddo Co.: Devil's Canyon, *Goodman 2089* (GH, NY, OKL, US); Hinton, *Demaree 12,330* (GH, MO, NY, OKL, PA, US); Fort Cobb-Andarko, *Hopkins, Nelson & Nelson 234* (MO, OKL, SMU, TEX, UC). Custer Co.: Weatherford, *Waterfall 451* (GH, OKL). Grady Co.: Chickasha, 20 May 1926, *Mrs. G. McNair* (MO, US). Kiowa Co.: Snyder, *O. Baldock 211* (TEX). Stephens Co.: Duncan Lake, *L. W. Mericle 613* (OKL). **TEXAS.** Wichita Co.: Big Wichita, 1880, *J. Ball* (GH). Clay Co.: Henrietta, *McBryde 251* (F). Tarrant Co.: Lake Worth, 4 April 1928, *Ruth 1512* (F, US). Hood Co.; Falls Creek, *Reverchon 1241* (F, K, MO, US). Eastland Co.: Rising Star, 16 April 1931, *B. G. Joyce* (TEX). Jones Co.: Anson, *Constance & Cory 3250.* Taylor Co.: Abilene, *Tolstead 7522* (GH, SMU). Navarro Co.: Dawson, *Reverchon 3893* (GH, MO, NY, US). McLennan Co.: Waco, *Ricker 3366* (US).

This is one of the two notably complex species in the subgenus. The types of both *Phacelia strictiflora* and *P. patuliflora* were collected "on the Brazos near San Felipe," where the two species overlap in range and were at first thought to be subject to considerable "contamination" by reciprocal exchange of genes. Field work seems to show, however, that these two species belong to two quite distinct genetic systems.

The following attempted explanation of the polymorphism found in *P. strictiflora* must be recognized as largely circumstantial and highly conjectural. No breeding studies have been attempted and genetic data, when available, may necessitate modification of this proposed scheme. I assume that var. *Lundelliana* represents the "pure" or "original" form of *P. strictiflora*, relatively unaffected by genes from other species. It occurs over a wide area and is extremely uniform, and it does not share much of its range with any other species of the subgenus. Morphologically, it stands at one end of the series of variations exhibited by the species population. In one of his exsiccatae, Reverchon designated this as "*P. strictiflora* var.," mistaking var. *connexa* for typical *P. strictiflora*, but gave it no infraspecific name. The range of var. *Robbinsii* coincides with the zone of overlap between *P. strictiflora* and *P. hirsuta* Nutt., and the slenderness of the branches and pedicels and the dissec-

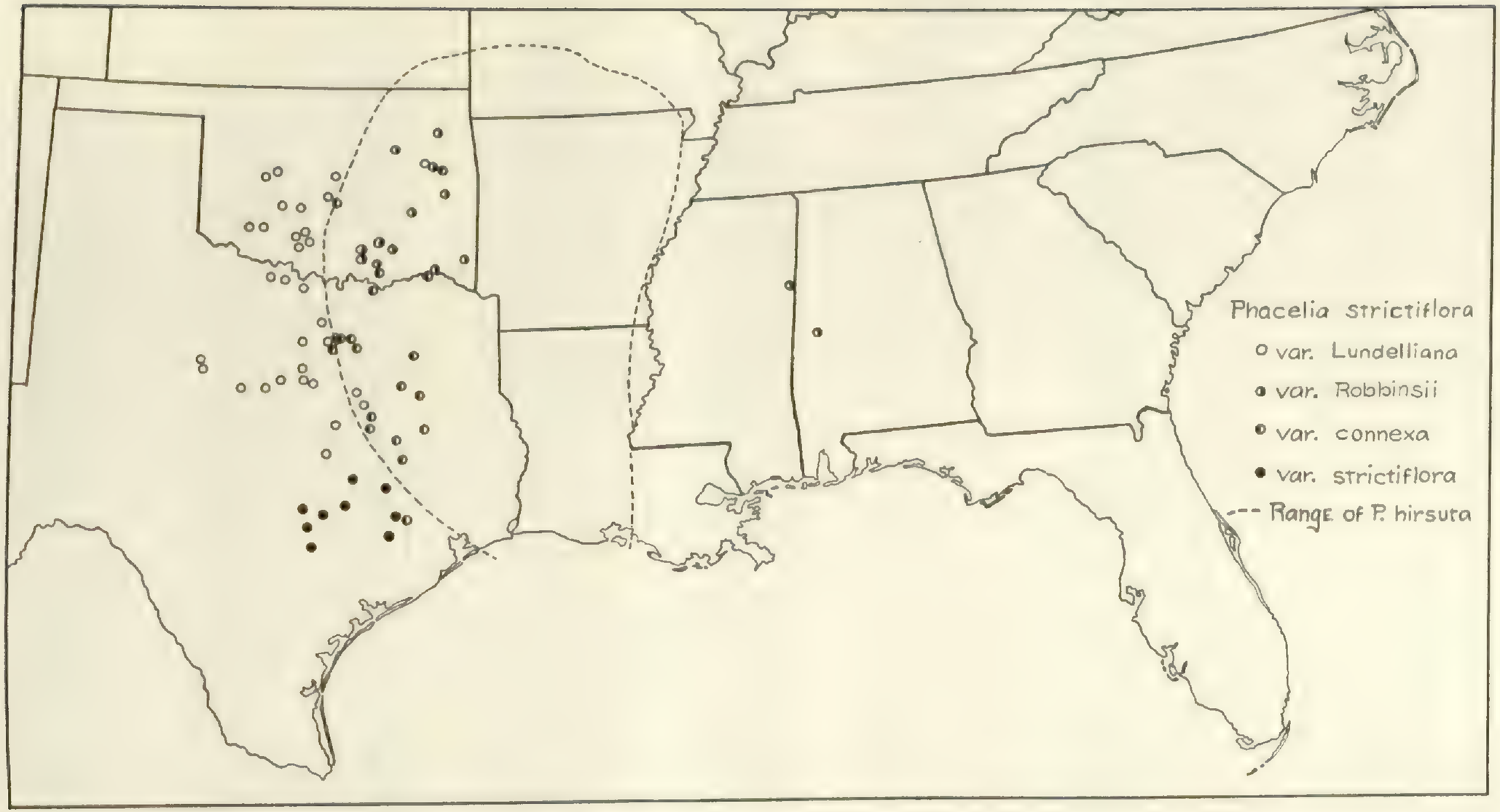


Fig. 3. Distribution of *P. strictiflora*.

tion of the cauline leaves are attributed to the influence of the latter species. Perhaps it was the existence of this phase that led Gray to remark (as quoted in Lindheimer's hand on sheet 217,098, MO): "*Ph. patuliflora* & *Ph. strictiflora* run all into *P. hirsuta* Nutt." In his critical discussion (1944) of *P. hirsuta*, *P. fallax* [*P. maculata*], and *P. gilioides*, Fernald confused var. *Robbinsii* with *P. gilioides;* his illustration of the seed of *P. gilioides* (op. cit., *pl. 815, f. 6*) is actually referrable to *P. strictiflora*. Although both var. *Robbinsii* and *P. gilioides* have an appressed pubescence, a more or less canescent inflorescence, and somewhat erose corolla lobes, the former is clearly distinguished by its pronounced basal rosette, usually scapose appearance, and much shorter and strictly erect fruiting pedicels. *Phacelia strictiflora* var. *connexa* is intermediate in most respects between vars. *Robbinsii* and *strictiflora*. The numerous cauline leaves, mostly about as large as the basal, are saliently pinnately lobed, and the pubescence is somewhat coarser than in the preceding. Its characters likewise suggest the influence of *P. hirsuta*, but the case is less clear than with var. *Robbinsii*. Finally, the phase to which the type of *P. strictiflora* belongs shows the influence of *P. hirsuta* in the frequently decumbent branches and longer pedicels, and its coarser and longer spreading pubescence. On the other hand, it is as difficult to separate cleanly from var. *connexa* as that variety is from var. *Robbinsii*.

If these multiple assumptions possess any validity, the puzzling diversity within the present species may be at least partly resolved on the assumed basis of genic inflow (or "introgression") from *P. hirsuta*. The distributional pattern of the forms concerned (fig. 3) appears to lend itself to such an interpretation. It should again be emphasized, however, that the cytological data are inconclusive (*P. hirsuta* and *P. strictiflora* each having 9 pairs of chromosomes), and that no genetical evidence has been procured.

4. **Phacelia patuliflora** (Engelm. & Gray) A. Gray, Proc. Amer. Acad. **10:** 321. 1875.

Eutoca patuliflora Engelm. & Gray, Boston Jour. Nat. Hist. **5:** 45. 1845.
Phacelia hispida Buckl. Proc. Acad. Soc. Phila. **1861:** 463. 1862, non A. Gray 1878.

Annual, 8–60 cm. high, branching from the base, the branches diffuse to rather stiffly ascending; stems densely spreading hirsute (especially at base) to finely strigulose, the inflorescence loosely hirsute to strigulose and canescent, rarely a little glandular; basal leaves neither conspicuously rosulate nor persistent, petiolate, truncate to cuneate at base, oblong to

oval, occasionally orbicular, 2–10 cm. long, 1–4 cm. broad, pinnately lobed, pinnatifid, or pinnate, with 1–7 pairs of smaller lobes or remote leaflets at base and a much larger terminal leaflet, all coarsely dentate or lobed with obtuse or acute teeth or lobes, the terminal leaflet often trilobed, strigulose to hirsute on both surfaces; cauline leaves mostly sessile, oblong to orbicular, coarsely dentate with 3–6 pairs of obtuse or acute teeth or lobes; inflorescence of simple terminal 5–30-flowered cymes, the mature pedicels widely spreading to weakly ascending or reflexed, 3–20 mm. long; calyx lobes narrowly oblong or lanceolate to obovate, 5–12 mm. long, 1–4 mm. broad, obtuse or acute, unequal or subequal, hirsute on the margins and strigulose to glabrate on both surfaces, spreading to ascending in fruit; corolla lavender to purplish-violet, usually with a conspicuous white center, broadly campanulate to rotate-campanulate, 8–20 mm. broad, the lobes obovate, finely crenulate, sparsely pilose on the back; gland flaps wholly adnate, puberulent; stamens included, 5–8 mm. long, the anthers oblong, 1–1.5 mm. long, the filaments villous on the lower ⅔; style included in flower, 5–8 mm. long in fruit, cleft about ⅔, hirsute below the middle, the summit of the ovary hirsute; mature capsule globose, 4–6 mm. in diameter; ovules 6–12 to each placenta; seeds 10–15, ovoid-angled, ca. 2 mm. long, brown, areolate and finely alveolate.

Branches decumbent; calyx lobes obtuse; fruiting pedicels spreading to reflexed; corolla pale lavender to violet. . . . a. var. *patuliflora*.
Branches rather stiffly ascending; calyx lobes acute; fruiting pedicels spreading-ascending; corolla bluish-lavender. . . . b. var. *teucriifolia*.

4a. **Phacelia patuliflora** var. **patuliflora**

TYPE LOCALITY: "woods near San Felipe, Texas," 1843, *Lindheimer II-280*.

DISTRIBUTION: Central and southeastern Texas and adjacent Mexico, chiefly on sandy soil of river terraces, and on alluvial soil of the Rio Grande valley and plain.

REPRESENTATIVE SPECIMENS: **TEXAS.** Falls Co.: Gurley, *Howell 366* (US). Burnet Co.: Burnet, *Wolff 1561* (TAES, US). Brazos Co.: Nellava, *Palmer 13,447* (MO, US). Austin Co.: San Felipe, *Lindheimer II-280* (GH: type of *Eutoca patuliflora* Engelm. & Gray, MO, NY). Bastrop Co.: opposite Bastrop, *Constance & Lundell 3241*. Travis Co.: Austin, April 1860. *Buckley* (PA: type of *P. hispida* Buckl., GH, MO), 7 April 1940, *Tharp* (CLOKEY, GH, MO, SMU, TAES). Harris Co.: Houston, *Bush 9* (MO, NY, US). Fort Bend Co.: Richmond, *Palmer 4946* (F, MO, US). Brazoria Co.: Columbia, *Bush 448* (MO, NY, US). Matagorda Co.: Matagorda, *Palmer 4859* (F, MO, US). Aransas Co.: Aransas Bay, *Constance & Lundell 3219*. Refugio Co.: Austwell, *Constance & Lundell 3217*. Bexar Co.: Elmendorf, *Parks 12,171* (GH, TAES). Uvalde Co.: Sabinal, *M. E. Jones 29,202* (MO). LaSalle Co.: Fowlerton, *Cory 28,544* (GH). Dimmit Co.: Carrizo Springs, *Palmer 33,744* (NY). San Patricio Co.: Nueces River, *Constance & Lundell 3221*. Nueces Co.: Flour Bluff, Padre Island, *Tharp 5609* (GH, TEX, US). Duval Co.:

Fig. 4. Distribution of *P. patuliflora*, *P. laxa*, *P. glabra*, and *P. fimbriata*.

San Diego, *Constance 3226*. Kleberg Co.: Kingsville, *Tracy 9190* (F, GH, MO, NY, TAES, TEX, US). Kenedy Co.: Sarita, *Constance & Lundell 3229*. Brooks Co.: Encino, *Constance & Lundell 3231*. Jim Hogg Co.: Hebronville, *Hanson 342* (GH, KSA, MO, NY, TEX, US). Cameron Co.: San Benito, *Constance & Lundell 3233, 3234;* Brazos de Santiago, *Nealley 120* (F, US). **TAMAULIPAS.** "circa Matamoras," *Berlandier 3190* (GH, NY, PA). **NUEVO LEÓN.** Monterrey, *Canby, Sargent & Trelease 167* (US).

Phacelia patuliflora as maintained here is a variable and perhaps synthetic species. If the broad gamut of morphological variations and combinations exhibited by the species population could be arranged in a linear series, *P. laxa* Small would stand at one end of the series, and *P. patuliflora* var. *teucriifolia* at the other. Thus, *P. patuliflora* has few if any characters which cannot be distinguished in one or the other of the assumed parents, but these characters are combined in a baffling variety of ways. Material from southern Texas and adjacent Mexico (*Tracy 9190, Berlandier 3190, Lundell & Lundell 10,749*) has the appressed pubescence of var. *teucriifolia* combined with the diffuse habit, blunt calyx lobes, and spreading pedicels of *P. laxa*. Collections from farther west (*Wolf 1561, Jones 29,195, 29,199*) possess the ascending branches and pedicels characteristic of var. *teucriifolia*, but their pubescence is spreading or loosely ascending. The geographical relationships of the three entities correspond roughly with the morphological sequence (fig. 4), and all have 9 pairs of chromosomes. Again, as in the case of *P. strictiflora*, no genetic evidence for or against the proposed hypothesis is as yet available.

The type specimen of *P. patuliflora* combines the diffuse habit and spreading pubescence (but much denser) of *P. laxa* with the sessile cauline leaves and large corolla of var. *teucriifolia*. A little nearer both in range and morphology to var. *teucriifolia* than the type of *P. patuliflora* is *P. hispida* Buckl. ("Austin, Texas"), but it is best retained within var. *patuliflora*.

4b. **Phacelia patuliflora** var. **teucriifolia** (Johnst.), comb. nov.
Phacelia teucriifolia Johnst. Jour. Arnold Arb. **24:** 98. 1943.

TYPE LOCALITY: Múzquiz, Coahuila, 12 April 1936, *Marsh 2120*.

DISTRIBUTION: Fort Worth and the Edwards Plateau region of Texas south to Coahulia, in the alluvial soil of draws and river bottoms.

REPRESENTATIVE SPECIMENS: **TEXAS.** Tarrant Co.: Fort Worth, 22 April 1914, *Ruth 459* (NY, US), 1 May 1920, *459* (F, KSA). Coleman Co.: ————, *Reverchon 97* (GH, MO). San Saba Co.: Richland Springs, *Fisher 103* (F). Tom Green Co.: San Angelo, *Reverchon 3896*

(MO, NY). Irion Co.: Mertzon, *Warnock 536* (Tex, US). Menard Co.: Menard, *Constance & Cory 3248*. Val Verde Co.: Pandale, *McVaugh 7709* (UC). **COAHUILA.** Múzquiz, *March 2120* (GH: type of *P. teucriifolia* Johnst., F), *2135* (F, GH).

An inhabitant of alluvial soil in the Edwards Plateau, on the Trinity River as far north as Fort Worth, and south into Coahuila, this may have been the "original" form of *P. patuliflora*. On the basis of the Mexican material, primarily, Johnston regarded this as a distinct species related to *P. strictiflora*. Whatever its primitive status, var. *teucriifolia* is now inseparably mixed into the species complex of *P. patuliflora*.

5. **Phacelia laxa** Small, Bull. Torrey Club **25:** 141. 1898.
Phacelia prostrata Brand; Engler, Pflanzenr. **4**[251]**:** 68. 1913.

Annual, 5–45 cm. tall, branching from the base, the branches succulent and brittle, diffuse, prostrate to ascending; stems sparsely hirsute with long spreading stiff hairs, the inflorescence hirsute to glabrate; basal leaves neither conspicuously rosulate nor persistent, petiolate, truncate at base, oblong-oval to oval, 2–8 cm. long, 1.2–3.5 cm. broad, pinnate or pinnatifid with 1 or 2 pairs of smaller remote leaflets or lobes at base and a much larger terminal leaflet or lobe, all shallowly dentate with usually obtuse teeth and the terminal leaflet usually trilobed, sparsely strigulose on both surfaces; cauline leaves mostly petiolate, oval to orbicular, shallowly dentate or the larger occasionally lobed with 2–4 pairs of obtuse teeth or lobes; inflorescence of simple terminal 8–20-flowered cymes, the mature pedicels widely spreading, 5–20 mm. long; calyx lobes oblanceolate to obovate, 5–9 mm. long, 1–4 mm. broad, obtuse, unequal, hirsute on the margins and sparsely strigulose to glabrate on both surfaces, spreading in fruit; corolla pale bluish-lavender with a whitish center, broadly campanulate, 8–12 mm. broad, the lobes oval to orbicular (about ½ as long as the tube), very finely crenulate, sparsely pilose on the back; gland flaps wholly adnate, glabrous; stamens included, 5 mm. long, the anthers oblong, 1 mm. long, the filaments sparsely villous below the middle; style included in flower, cleft ½ to ⅔, 3–5 mm. long in fruit, sparsely hirsutulous below the middle, the summit of the ovary hirsute; mature capsule globose, 3–5 mm. in diameter; ovules usually 4 to each placenta; seeds 4–8, ovoid-angled, 2–2.5 mm. long, brown, areolate and finely alveolate.

Type locality: "along Neueces Bay, Neueces County, Texas," *Heller 1446*.

Distribution: Southeastern Texas near the Gulf of Mexico, and inland along the rivers, in moist heavy soil of shaded alluvial thickets.

Specimens examined: **TEXAS.** ? Kendall Co.: Edge Falls, 26 March 1938, *Parks* (UC). Gonzales Co.: ————, 22 April 1938, *E. F. Owen* (GH, UC). Jackson Co.: Ganado, *Palmer 9022* (PA, US), *Constance & Lundell 3214*. Victoria Co.: Victoria, *Lindheimer III-479* (type collection

of *P. prostrata* Brand, F, GH, MO, PA, UC), *Constance & Lundell 3216.* San Patricio Co.: Sinton, *Constance & Lundell 3220.* Nueces Co.: Nueces Bay, *Heller 1446* (NY: type of *P. laxa* Small, GH, K, MO, PA, UC, US); Calallen, *Constance & Lundell 3222.* Jim Wells Co.: *Constance 3223.*

This is exceedingly difficult to separate from *P. patuliflora* in the herbarium, as might be expected if my assumption as to the synthetic character and the ancestry of the latter species is correct. Since all the characters of *P. laxa,* except perhaps the low number of ovules, have been diffused into *P. patuliflora,* its distinctness rests solely upon a combination of characters, none of which is clearly distinguishing in itself. In the field, however, it is easily recognized by its small pale flowers, petiolate cauline leaves, sparse pubescence, and preference for shaded alluvial situations. I regard it as a species restricted rather closely to this type of habitat, and presume that it has been very nearly "swamped out" by the competition offered by its own recombination products with *P. patuliflora* var. *teucriifolia.* Macbride has pointed out that Brand overlooked the publication of *P. laxa* Small, and so described the same entity as *P. prostrata* ("bei Victoria am Guadalupe River").

6. **Phacelia hirsuta** Nutt. Trans. Amer. Philos. Soc. N. S. **5:** 191. 1837. *Phacelia parviflora* var. *hirsuta* A. Gray, Proc. Amer. Acad. **10:** 321. 1875. *Phacelia dubia* var. *hirsuta* Trel. Rep. Ark. Geol. Surv. 1888. **4:** 205. 1891.

Annual, 10–50 cm. high, simple or usually branching at base or above, the branches erect or ascending; stems densely hirsute with stiff spreading hairs, the inflorescence hirsutulous and spreading-hirsute; basal leaves petiolate, oblong, 2–4.5 cm. long, 0.8–2.5 cm. broad, pinnate or pinnatifid with 2–4 pairs of oval to orbicular, entire or toothed, often petiolulate leaflets or lobes and a larger trilobed orbicular to obovate terminal leaflet or lobe, the cauline leaves oblong to orbicular, usually short-petiolate but sometimes sessile and somewhat clasping, pinnately lobed to pinnatifid, rarely merely toothed, with 2–4 pairs of linear to oval, acute or obtuse lobes, strigose on both surfaces; inflorescence of simple terminal 10–25-flowered cymes, the mature pedicels spreading-ascending to spreading, 3–15 mm. long; calyx lobes linear to oblanceolate, 5–10 mm. long, 1–3 mm. broad, unequal, obtuse, strigose and strigulose on both surfaces, spreading to slightly reflexed in anthesis, erect or ascending in fruit; corolla light bluish-lavender with a whitish center and 2 purple spots on the proximal edge of each lobe, rotate-campanulate, 8–13 mm. broad, the lobes orbicular, entire, pilose on the back; gland flaps wholly adnate, puberulent; stamens usually included, 4–6 mm. long, the anthers oblong, about 1 mm. long, the filaments densely villous on their lower ⅔; style included in flower, when mature 5–6 mm. long, cleft ⅓ to ½, hirsutulous at base, the

summit of the ovary hirsute; mature capsule subglobose, 3.5–4 mm. in diameter; ovules usually 4 to each placenta; seeds 6–8, ovoid-angled, ca. 2 mm. long, brown, areolate and finely alveolate.

TYPE LOCALITY: "In sylvan prairies; common from the Cadron to the garrison at Belle Point, Arkansas," *Nuttall.*

DISTRIBUTION: Southern Missouri and southeastern Kansas, south to Louisiana and northeastern Texas, in borders and openings of deciduous woods.

REPRESENTATIVE SPECIMENS: **MISSOURI.** Oregon Co.: Alton, *Steyermark 5155* (F, MO). Howell Co.: Lanton, *Steyermark 5153* (F, MO). Webster Co.: Fordland, *Steyermark 19,256* (MO). McDonald Co.: Pineville, *Palmer 39,288* (US). **KANSAS.** Cherokee Co.: ————, *Hitchcock 1087* (GH—part, KSA—part, MO, NY, US—part). Neosha Co.: Thayer, June 1890, *H. Darnell* (KSA). **ARKANSAS.** "Arkansas," *Nuttall* (type collection of *P. hirsuta* Nutt., GH, PA). Clay Co.: Corning May 1884, *Letterman* (F, MO, NY, PA, US—part). Carroll Co.: Eureka Springs, *Palmer 5626* (MO, TENN). Drew Co.: Monticello, *Demaree 21,122* (MO, NY, TEX). Hot Spring Co.: Magnet Cove, *Demaree 14,830* (DUKE, F, GH, MO, NY, OKL, TENN, TULA, UC, WVA). Nevada Co. Prescott, *Bush 258* (GH, K, MO, NY, US, WVA). **LOUISIANA.** Iberia Parish: Saline Island, *Langlois 105* (NY, PENN, US). Rapides Parish: Alexandria, *Hale 200* (PA). Calcasieu Parish: Lake Charles, *Benke 5541* (F, US). **OKLAHOMA.** Creek Co.: Sapulpa, *Bush 917* (K, MO, NY). Muskogee Co.: Webbers Falls, *Goodman 2137* (GH, MO, NY, OKL. US). Le Flore Co.: Pine Valley, *Goodman 2493* (GH, MO, NY, OKL). McCurtain Co.: ————, *Little & Olmstead 1563* (OKL, US). Johnston Co.: Tishomingo, *Robbins 2407* (UC). **TEXAS.** "Texas," *Drummond III-299* (GH, K, NY, PA). Lamar Co.: Arthur City, *Constance & Lundell 3256;* Paris, *Constance & Lundell 3257.* Wood Co.: Golden, 16 April 1926, *E. McMullen* (TEX). Limestone Co.: Fort Parker, *Constance & Cory 3244.* Orange Co.: Sabine River—Orange, *Small & Wherry 11,795* (NY). Chambers Co.: ————, 7–10 April 1936, *Tharp* (NY, TEX).

This well marked species, characterized by its long and spreading pubescence, is in serious danger of being confused only with *P. gilioides* and *P. maculata*, both of which have closely appressed hairs and a canescent inflorescence. Some apparent shade forms with atypically shallowly lobed cauline leaves have been incorrectly cited as evidence for the occurrence of *P. patuliflora* in Arkansas. The suggested relationship of *P. hirsuta* to *P. strictiflora* and to *P. gilioides* is detailed in the accounts of those species. Brand's description of this species as "planta biennis" is quite inexplicable; both in the field and under cultivation, *P. hirsuta* behaves as an orthodox annual.

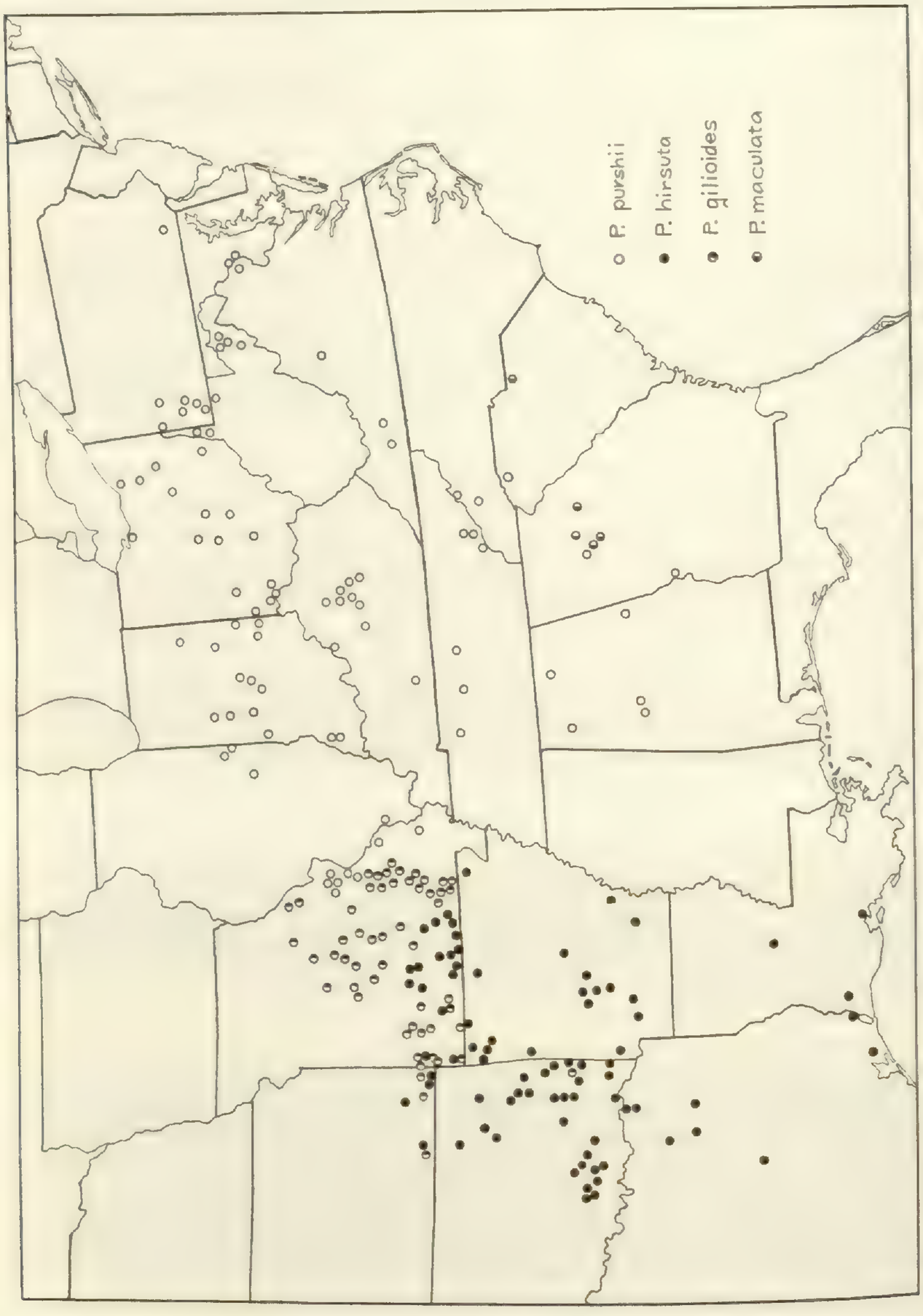


Fig. 5. Distribution of *P. hirsuta*, *P. gilioides*, *P. maculata*, and *P. Purshii*.

7. **Phacelia gilioides** Brand; Engler, Pflanzenr. 4[251]: 63. 1913.

Annual, 10–40 cm. high, simple or usually branching at or above the base, the branches erect or ascending; stems thinly strigose with stiff afflexed hairs, the inflorescence densely strigulose and strigose, canescent; basal leaves petiolate, oblong, 1.5–5 cm. long, 0.8–3 cm. broad, pinnate to pinnatifid with 2–5 pairs of oblong to orbicular, entire or toothed, usually petiolulate leaflets or lobes and a larger entire or trilobed terminal leaflet or lobe, the cauline leaves short-petiolate to sessile and somewhat clasping, oblong to orbicular, pinnatifid or deeply pinnately lobed with 2–4 pairs of linear-lanceolate to oblong, usually acute lobes, strigose on both surfaces; inflorescence of simple terminal and axillary 8–25-flowered cymes, the mature pedicels loosely ascending to spreading, 5–15 mm. long; calyx lobes lanceolate to oblong, 5–8 mm. long, 0.5–2 mm. broad, subequal, acute or obtuse, hirsute-ciliate with stiff pustular-based hairs and strigulose on both surfaces, ascending in anthesis, ascending to spreading in fruit; corolla deep lavender, rotate-campanulate, 8–15 mm. broad, the lobes orbicular, fimbriate to denticulate, pilose on the back; gland flaps wholly adnate, glabrous; stamens usually included, 4–6 mm. long, the anthers oblong, about 1 mm. long, the filaments densely villous on their lower 4/5; style included in flower, when mature 5–7 mm. long, cleft ⅓ to ½, hirsutulous on the lower ¼, the summit of the ovary hirsute; mature capsule subglobose, 3–4 mm. in diameter; ovules usually 4 to each placenta; seeds 6–8, ovoid-angled, 1.5–2 mm. long, dark brown, areolate and finely alveolate.

Type locality: "Missouri: Corn-Creek in Ozarkgebirge," *Hoffman.*

Distribution: Central and southern Missouri to adjacent Kansas and Oklahoma, and probably Arkansas, in deciduous woods and on limestone barrens.

Representative specimens: **KANSAS.** Cherokee Co.: ————, *Hitchcock 1087* (GH—part, KSA—part, US—part). Labette Co.: Oswego, 5 May 1891, *Newton* (KSA, US). **MISSOURI.** Pike Co.: Cyrene, *Steyermark 28,609* (MO). Cooper Co., ————, *Bush 14,787* (DUKE, MO, US). Washington Co.: Potosi, 1861, *Peck* (F, GH, MO). Iron Co.: Ironton, 26 May 1918, *Churchill* (GH, MO, UC). Scott Co.: Benton, *Steyermark 10,250* (CLOKEY, MO). Jasper Co.: Joplin, *Palmer 1879* (GH, MO, US); Webb City, *Palmer 1928* (GH, MO, US). Barry Co.: Eagle Rock, *Bush 219* (F, GH, MO, UC, US, WVA), *180* (KSA, MO, UC, US, WVA). McDonald Co.: Noel, *Bush 5617* (GH, MO, US). **OKLAHOMA.** Le Flore Co.: Page, *Stevens 1377* (GH, OKL, US).

Phacelia gilioides differs from *P. hirsuta* by its closely appressed pubescence and the canescence of the inflorescence (as pointed out by Fernald), and from *P. Purshii* by the pubescent corolla lobes, more numerous ovules, and usually smaller seeds. It will be seen, indeed, that *P. gilioides* has no characters which cannot be referred to either *P. hirsuta* or *P. Purshii*, although it is usually more like the former in general appearance. The fact

that the geographical range of *P. gilioides* overlaps that of *P. hirsuta* on the southwest and that of *P. Purshii* on the east (fig. 5) suggests the possible explanation that *P. gilioides* is the result of hybridization between these two species. Neither cytological nor genetical data are as yet available to test this hypothesis, but it should afford an interesting problem for someone situated in the Missouri region. If this interpretation is borne out by further evidence, it will be an addition to those few species which are known to have been derived from others still living. Despite their frequently close resemblance, *P. hirsuta* and *P. gilioides* appear to have been mixed under the same number only by Hitchcock in his exsiccatae from southeastern Kansas. The second of the two collections cited by Brand in the original description is a representative of *P. hirsuta.*

8. **Phacelia maculata** Wood, Amer. Bot. & Flor. 244. 1870.
Phacelia fallax Fernald, Rhodora **46:** 51, *pl. 814, f. 1–4.* 1944.

Annual, 10–40 cm. high, simple or usually branching at or above the base, the branches erect or ascending; stems strigose with rather stiff afflexed hairs; the inflorescence strigulose and strigose, canescent; basal leaves petiolate, oblong to oblong-oval, 1.5–5 cm. long, 0.8–2 cm. broad, pinnate or pinnatifid with 1–3 pairs of oval to orbicular, toothed or entire, often petiolulate leaflets or lobes and a much larger trilobed obovate-cuneate terminal leaflet or lobe, the cauline leaves short-petiolate to sessile, oblong-oval to orbicular, pinnately lobed with 2 or 3 pairs of oblong to oblong-obovate obtuse lobes, strigose on both surfaces; inflorescence of simple terminal 8–25-flowered cymes, the mature pedicels ascending to spreading-ascending, 4–10 mm. long; calyx lobes linear-oblong, 5–8 mm. long, about 1 mm. broad, obtuse, subequal, hirsute-ciliate with stiff pustular-based hairs and strigulose on both surfaces, ascending in anthesis; corolla deep lavender, rotate-campanulate, 7–11 mm. broad, the lobes orbicular, minutely crenulate, pilose on the back; gland flaps wholly adnate, glabrous; stamens usually included, 5–6 mm. long, the anthers oblong, 0.8–1.25 mm. long, the filaments densely villous on their lower 4/5; style included in flower, when mature 4–5 mm. long, cleft about ½, hirsutulous on the lower ½, the summit of the ovary hirsute; mature capsule subglobose, 3–4 mm. in diameter; ovules usually 4 to each placenta; seeds 6–8, ovoid-angled, ca. 2 mm. long, brown, areolate and finely alveolate.

Type locality: "Stone Mountain, Georgia, and westward," *Wood.*

Distribution: Mountains of northern Georgia to adjacent South Carolina and Alabama, on granitic rocks.

Representative specimens: **SOUTH CAROLINA.** Lancaster Co.: Forty-Acre Rock, *D. Huntley 210* (DUKE); Greenville Co.: 14 miles north of Travelers Rest, *McVaugh 8645* (UC). **GEORGIA.** Clarke Co.: Athens, 14 April 1930, *Pyron* (DUKE, GH), *Cronquist 4371* (GA, GH).

Gwinnet Co.: Thompsons Mills, *Allard 206* (US). DeKalb Co.: Stone Mt., *Biltmore Herb. 4263* (GH, MO, PA, UC, US), May 1869, *Canby* (GH, MO, UC), 20 May 1897, *Eggert* (MO, US), *Palmer 39,909* (GH, MO, US), *Curtiss 6458* (GH: type of *P. fallax* Fern., F, KSA, MO, UC, US). Rockdale Co.: Big Haynes Creek, *Pyron & McVaugh 2552* (GA). **ALABAMA.** Randolph Co.: Blake's Ferry, *McVaugh 8605* (UC).

Fernald (1944) has ably assembled characters to distinguish *P. maculata* (as *P. fallax*) from *P. hirsuta*, but he apparently did not realize that an even more critical problem is to separate *P. maculata* from *P. gilioides*. Although the admittedly weak characters employed in the present key are the best I can find to distinguish them, I hesitated to consider them conspecific even before I was aware of the unusual chromosome number in the Appalachian species. *Phacelia maculata* is known only from granitic "flatrocks" in the southern Appalachians, and *P. gilioides* apparently grows mostly on or near limestone "barrens" in the Ozark region. Because of the suggestions made above as to the possible hybrid origin of *P. gilioides*, it is interesting to find so much difficulty in distinguishing that species from *P. maculata*. Although *P. Purshii* and *P. maculata* occur in approximately the same area, *P. hirsuta* is not known from anywhere near, and I cannot visualize any other species which might replace it as a potential ancestor of *P. maculata*. While *P. gilioides* is variable, pretty well bridging the morphological gap between *P. Purshii* and *P. hirsuta* and making it awkward to describe and key, *P. maculata* is extremely uniform and hence easier to recognize than my key would suggest.

McVaugh has been criticized by Fernald because the former's association of this species (as *P. hirsuta*) with granitic outcrops (1943) does not take into account a collection purportedly from Giles County, Virginia. This record, based on a single printed label of Canby's in the Gray Herbarium, is doubtless an error. According to his labels, Canby collected both on Stone Mountain, Georgia, and in Giles County, Virginia, in May, 1869. Canby specimens of *P. maculata* in other herbaria all bear a Georgia label. Furthermore, the only collections thus far seen from outside Georgia are from South Carolina or Alabama.

9. **Phacelia glabra** Nutt. Trans. Amer. Philos. Soc. N. S. **5:** 192. 1837. *Cosmanthus nemophiloides* Kunth, Ind. Sem. Hort. Berol. 12. 1846.

Annual, 5–40 cm. high, simple and erect or usually branched from near the base, the branches erect or ascending, slightly succulent; stems and inflorescence rarely with a few scattered stiff afflexed hairs; basal leaves petiolate, oblong to oblong-oval, 1.5–4 cm. long, 0.5–1.5 cm. broad, pinnate

or pinnatifid with 2–4 pairs of oval to orbicular entire or toothed leaflets or lobes and a larger 3- or 5-lobed terminal leaflet or lobe, most of the cauline leaves sessile and clasping, oval to broadly ovate, deeply pinnately lobed with 1–5 pairs of lanceolate to oblong, acute or obtuse lobes, strongly hirsute-ciliate and sometimes sparsely strigulose on one or both surfaces; inflorescence of simple terminal or axillary 5–15-flowered cymes, the mature pedicels spreading-ascending or spreading, 6–12 mm. long; calyx-lobes narrowly oblong to oval, 2–4 mm. long, 0.5–2 mm. broad, usually unequal, obtuse, hirsute-ciliate, the surfaces usually glabrous, erect or ascending in fruit; corolla deep bluish-lavender with a whitish center and 2 purple spots on the proximal end of each lobe, rotate-campanulate, 5–12 mm. broad, the lobes orbicular, entire, sparsely pilose on the back; gland flaps wholly adnate, glabrous; stamens about as long as the corolla, 3–5 mm. long, the anthers oblong, about 0.8 mm. long, the filaments densely villous on their lower ½; style included in flower, when mature 3–5 mm. long, cleft about ½, glabrous, the summit of the ovary glabrous, or with a very few stiff hairs; mature capsule globose, 3–4 mm. in diameter; ovules usually 4 to each placenta; seeds 4–8, ovoid-angled, ca. 2 mm. long, brown, areolate and finely alveolate.

TYPE LOCALITY: "In humid and elevated woods on the margins of rivulets, near the Dardenelles settlement, Arkansas river," *Nuttall*.

DISTRIBUTION: Arkansas and adjacent Oklahoma south to Louisiana (?) and northeastern Texas, in sandy loam of prairies or at the edge of deciduous woods.

REPRESENTATIVE SPECIMENS: **ARKANSAS.** "Red River," *Nuttall* (GH, K, NY, PA). White Co.: Bald Knob, *Demaree 17,126* (F, MO, OKL). Bradley Co.: Warren, *Demaree 18,947* (CLOKEY, GH, MO, NY, TULA). Pulaski Co.: Little Rock, *Demaree 17,135* (CLOKEY, MO, NY). Nevada Co.: Prescott, *Bush 254* (MO, NY, US). **? LOUISIANA.** "Wet prairies, Louisiana, Georgia," *Leavenworth* (NY). **OKLAHOMA.** Haskell Co.: Stigler, *B. Osborn 1510R* (US). Le Flore Co.: Talihina, *Robbins 2352* (UC). Choctaw Co.: Hugo, *Constance & Lundell 3235*. **TEXAS.** Kaufman Co.: Terrell, *Reverchon 3894* (GH, MO, US). San Augustine Co.: San Augustine, *G. L. Crocket* (US). Falls Co.: S. of Kosse, *Constance & Cory 3246*. Harris Co.: Houston, *Lindheimer I-134* (GH, MO, PA), *Hall 673* (F, GH, MO, NY, PA, US). Austin Co.: San Felipe, *Constance & Lundell 3212*.

This is a quite distinct species, perhaps because of its unique chromosome number, which may have protected it from interbreeding with any of its relatives. It has been collected rather seldom and probably has a broader range than the available collections indicate. In some herbaria it has been hidden under the name "*P. dubia*," a species with which it has little in common except small flowers. *Cosmanthus nemophiloides* Kunth ("Texas") appears to be the same, the phrase "placentis biovulatis"

being in error, since no biovulate species of this group are known from Texas.

10. **Phacelia dubia** (L.) Trel. Rep. Ark. Geol. Surv. 1888. **4:** 205. 1891.
Polemonium dubium L. Sp. Pl. 163. 1753.
? *Heteryta polemonioides* Raf. Med. Repos. N. Y. **5:** 353. 1808.
Phacelia parviflora Pursh, Fl. Am. Sept. 140. 1814.
Eutoca parviflora R. Br. in Richards. Bot. App. Franklin's Journ. 764. 1823.
Phacelia pusilla Buckl. Amer. Jour. Sci. **14:** 172. 1843, non Torr. 1871.
Cosmanthus parviflorus A. DC. Prodr. **9:** 297. 1845.
Phacelia dubia var. *interior* Fernald, Rhodora **46:** 5. 1944.

Annual, 5–40 cm. high, usually branching from the base and the branches ascending; stems and inflorescence strigose with stiff flattened afflexed hairs and beset with slender-stalked capitate glands, the inflorescence canescent; cotyledons usually withering by anthesis, ovate-orbicular, sparsely strigulose above, glabrous beneath; basal leaves petiolate, oval to oblong, 1.5–6 cm. long, 1–5 cm. broad, pinnate or pinnatifid with 1–5 pairs of oval to orbicular, entire or toothed leaflets or lobes and a larger or subequal terminal trilobed or entire leaflet or lobe, the cauline leaves oblong or lanceolate to orbicular, short-petiolate to sessile, rarely entire to deeply lobed with 1–4 pairs of lanceolate to ovate acute lobes, strigose and glandular on both surfaces; inflorescence of terminal and axillary 8–30-flowered simple cymes, the mature pedicels spreading-ascending, or the lower spreading, 3–22 mm. long; calyx lobes linear-lanceolate to ovate, 3–7 mm. long, 1–2 mm. broad, strigose on the dorsal surface, especially on the margins, obtuse or acute, often unequal; corolla blue to white, rotate-campanulate, 5–10 mm. broad, the lobes orbicular, entire, pilose on the back; gland flaps wholly adnate, glabrous, a little divergent distally; stamens a little exserted, 3–5 mm. long, the anthers oblong, about 1 mm. long, the filaments densely villous on their lower ⅔; style included in flower, when mature 4–5 mm. long, cleft about ½, glabrous, the summit of the ovary hirsute; mature capsule globose-ovoid, 2–3 mm. in diameter; ovules 2–4 to each placenta; seeds 4–6, ovoid-angled, 1.5–1.75 mm. long, brown, finely reticulate.

Basal leaves with 1–3 pairs of lateral and a larger usually 3-lobed terminal leaflet; cauline leaves with 1–3 pairs of rather broad lobes ..... **a. var. *dubia*.**
Basal leaves with 4–5 pairs of lateral and a subequal entire terminal leaflet; cauline leaves with 2–4 pairs of narrow lobes. **b. var. *georgiana*.**

10a. **Phacelia dubia** var. **dubia** McVaugh, Ecol. Monogr. **13:** 160. 1943.

TYPE LOCALITY: "in Virginia," *Clayton*.

DISTRIBUTION: Central Pennsylvania (two stations in central New York) to Georgia and Alabama, west to West Virginia and Tennessee, on shaded rocks or on alluvial soil.

REPRESENTATIVE SPECIMENS: **NEW YORK.** Onondaga Co.: Jamesville,

21 May, *Mrs. L. L. Goodrich* (US); Green Lake, November 1903, *Mrs. L. L. Goodrich* (NY). **PENNSYLVANIA.** Snyder Co.: Blue Mt., *Wiegand & Wiegand 2677* (F, GH). Lancaster Co.: York Furnace—Tucquan, 11 May 1901, *Heller* (F, GH, US). Fulton Co.: Harrisonville, *C. E. Wood, Jr. 1981* (PENN). Washington Co.: California, *Banker 768* (NY). **DELAWARE.** New Castle Co.: Ogletown, *Tatnall 3295* (GH, PENN). **MARYLAND.** Cecil Co.: Octoraro, 30 May 1907, *Williamson* (PENN). Montgomery Co.: Plummers Island, *Eggleston 4314* (F, GH, MO, PA, US), *Constance, Bomhard & Swallen 3019;* High Island, 6 May 1896, *Steele* (DUKE, GH, MO, US). Washington Co.: opposite Harpers Ferry, *Constance & McVaugh* (*Gray. Exsicc. 1388*) (GH, MO, PENN, SMU, TENN, TEX, UC). **D. C.** ————, 1897, *Pollard* (F, GH, KSA). **WEST VIRGINIA.** Jefferson Co.: Harpers Ferry, *Pursh* (type collection of *P. parviflora* Pursh?, K). Mineral Co.: Ridgeville, *Core, Bartholomew & Myers* (CLOKEY, WVA). Greenbriar Co.: White Sulphur Springs, 14–17 April 1914, *Hunnewell* (GH, HUNNEWELL). Raleigh Co.: Batoff Mt., *Tosh 115* (KY). **VIRGINIA.** "Virginia," *Clayton 556* (type of *Polemonium dubium* L., GH: photo). Stafford Co.: Falmouth, *Hermann 10,545* (NY, PA). Shenandoah Co.: Woodstock, *Allard 7678* (GH, MO, US); Mt. Jackson & Edinburg, *Palmer 42,585* (GH, MO, NY). Dinwiddie Co.: Burgess Station, *Fernald & Long 10,014* (F, GH, MO, PENN, US). Greenville Co.: Emporia, *Fernald & Long 7995* (GH, NY, PENN), *Fernald & Lewis 14,541* (GH, PA, SMU). Bedford Co.: ————, 18 May 1873, *Curtiss* (GH, MO, UC). Russell Co.: Carbo Station, *Eggleston 17,635a* (US). **TENNESSEE.** Knox Co.: Knoxville, April 1895, *Ruth* (MO, NY, PA, UC, US). Blount Co.: Walland, *Jennison 2197* (*Gray. Exsicc. 863*) (F, GH, MO, OKL, PA, PENN, TENN, TEX, UC, US, WVA). Wilson Co.: Vesta, *Svenson 7759* (DUKE, GH, NY, TENN). Rutherford Co.: Lavergne, *Sharp & Shanks 443* (CLOKEY, MO, NY, OKL, TENN, TEX, WVA). Davidson Co.: Nashville, April 1878, *Gattinger* (GH: type of *P. dubia* var. *interior* Fern., MO), *Gattinger* (*Curtiss 2131*) (F, GH, MO, NY, PENN, US), *Hubbard 2131* (KSA, MO—part, NY, UC). **NORTH CAROLINA.** Halifax Co.: Weldon, 27 April 1897, *Small* (NY). Craven Co.: Newbern, *Leeds 2502* (PA). Buncombe Co.: Biltmore, *Biltmore Herb. 786b* (F, GH, MO, NY, PA, US). Swain Co.: Bryson City, 15 April 1937, *L. Barksdale* (DUKE, NY). **GEORGIA.** DeKalb Co.: Stone Mt., May 1869, *Canby* (F, NY, US). Muscogee Co.: Columbia, *Boykin* (GH, NY, PA). **ALABAMA.** "Alabama," 1840, *Buckley* (type collection of *P. pusilla* Buckl., MO, NY). Jackson Co.: Long Island, 14 May 1935, *Porter* (GH).

Phacelia dubia is another very distinct species, remarkable for possessing (with *P. maculata*) the lowest chromosome number known in the family. *Phacelia parviflora* Pursh ("on rocks near Harper's Ferry, on the Potowmac") and *P. pusilla* Buckl. ("prairies of Alabama") are the same. Fernald's var. *interior*

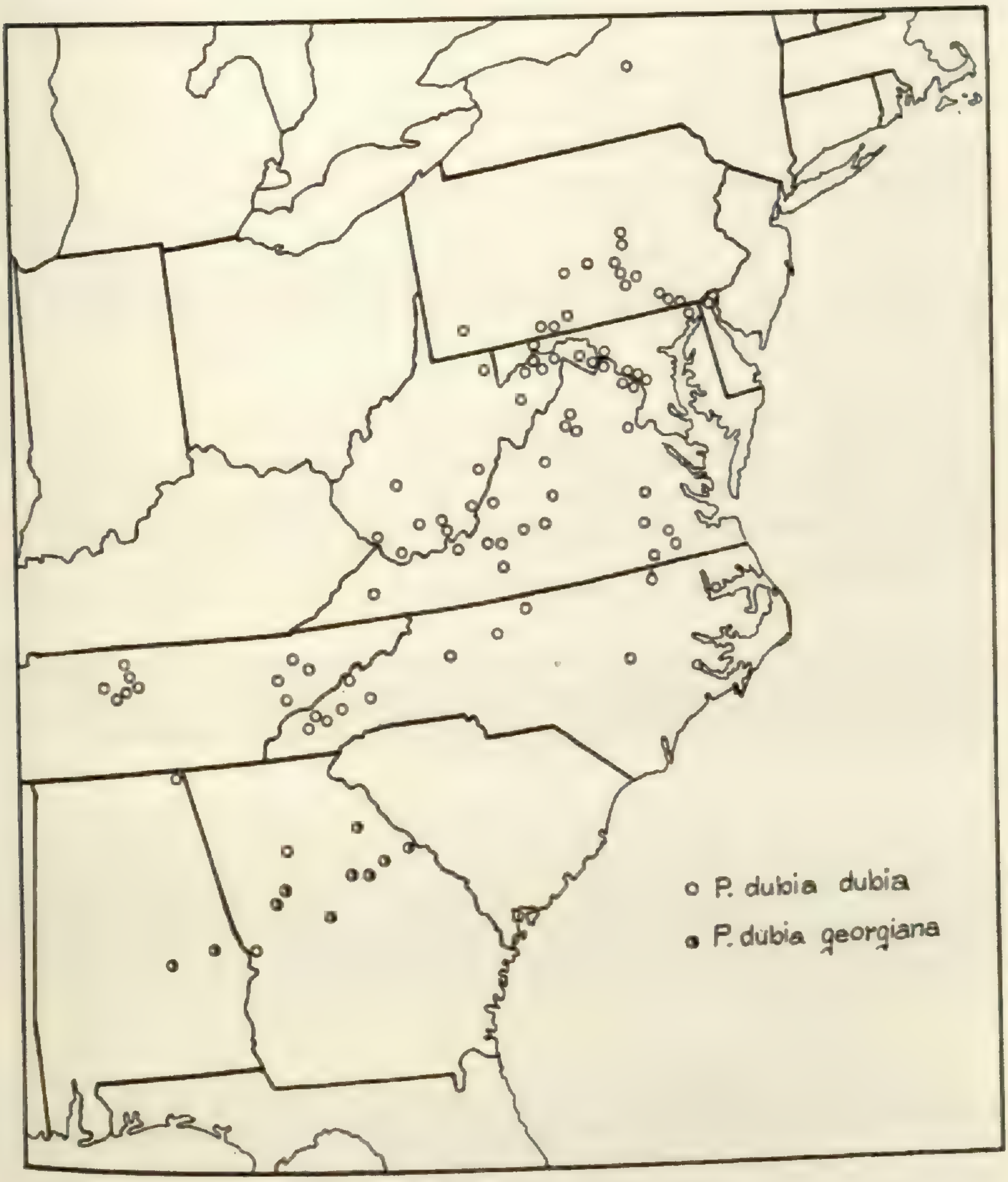


Fig. 6. Distribution of *P. dubia*.

("gregarious in open shrubberies and pastures or in open grounds, Nashville") was based upon dwarfed plants with short pedicels, which (on the basis of more material) are revealed to occur sporadically throughout the range of the species, e. g., Pennsylvania, Virginia, and Tennessee, although they may be especially abundant on calcareous substrata.

This appears to be typically an Appalachian species which has spread onto the Coastal Plain, in southern Virginia and North Carolina. It does not occur west of the Applachians, and is wholly absent from Kansas, Arkansas, Missouri, Oklahoma, and Texas, in all of which it has been reported on the basis of misidentifications. The accepted name was published in the report of the geological survey of Arkansas, but the specimens attributed to this species were actually of *P. hirsuta*.

Although widespread, *P. dubia* appears to have no well marked regional phases except for the following, which is associated with granitic rocks in northern Georgia and Alabama. It should be expected in similar situations in South Carolina.

10b. **Phacelia dubia** var. **georgiana** McVaugh, Ecol. Monogr. **13:** 160. 1943.

TYPE LOCALITY: "Echol's Mill, 12 miles northeast of Lexington," Oglethorpe County, Georgia, *Pyron & McVaugh 2448*.

DISTRIBUTION: Granitic flatrocks of northern Georgia and Alabama.

REPRESENTATIVE SPECIMENS: **GEORGIA.** Oglethorpe Co.: Echol's Mill, *Pyron & McVaugh 2448* (GA: isotype of *P. dubia* var. *georgiana* McVaugh). Columbia Co.: Heggie's Rock, *Hermann 10,107* (F, GH, MO, NY, PA, US). Hancock Co.: Sparta, *Hermann 10,153* (F, GH, MO, NY, PA). Pike Co.: Concord, *Pyron & McVaugh 2296* (DUKE, GA, TULA). Bibb Co.: Mason, *Pyron & McVaugh 1524* (GA, US). **ALABAMA.** Lee Co.: Auburn, 10 April 1897, *Earle & Baker* (F, GH, KSA, MO, NY, US), *Earle & Earle 61* (MO, NY, US). Elmore Co.: Tallassee, *Harper 82* (GH, MO, NY, US).

11. **Phacelia bipinnatifida** Michx. Fl. Bor. Amer. **1:** 134. 1803.
Phacelia pubescens Poir. in Lam. Encycl. **5:** 239. 1804, non Peter 1893.
Phacelia simplex Pers. Syn. **1:** 168. 1905. (Nomen.)
Endiplus bifidus Raf. Amer. Monthl. Mag. **3:** 356. 1818.
Endiplus phaceloides Raf. Jour. de Phys. 99. 1819.
Phacelia Endiplus Steud. Nom. ed. 2. **2:** 313. 1841. (Nomen.)
Phacelia brevistylis Buckl. Amer. Jour. Sci. I. **45:** 172. 1843.
Phacelia bipinnatifida var. *Plummeri* Wood, Class Book 438. 1847.
Phacelia bipinnatifida var. *brevistylis* A. Gray, Proc. Amer. Acad. **10:** 320. 1875.

Biennial, 10–60 cm. high, branching above the base, the branches ascending to erect; stems hirsute with spreading or deflexed stiff hairs,

more densely so at base, the inflorescence spreading-hirsutulous or -hirsute and glandular-villous with small slender-stalked glands; basal leaves petiolate, triangular-ovate, 3–12 cm. long and broad, pinnate with 1–3 pairs of large ovate to lanceolate leaflets, these pinnately toothed to pinnatifid with mostly acute divisions, the cauline leaves all petiolate, like the basal but reduced upwards and often less divided, sparsely strigose or strigulose on the upper surface, paler and often glabrate on the lower, the rachises and petioles sparsely hirsute and glandular-villous; inflorescence of paired or clustered terminal 5–25-flowered cymes, the mature pedicels arcuately recurved, 6–15 mm. long; calyx lobes linear, 4–8 mm. long, 0.5–1.5 mm. broad, subequal, acute, strigose and glandular-villosulous on both surfaces; corolla bluish-lavender, broadly campanulate, 10–15 mm. broad, the lobes obovate, minutely crenulate, pilose on the back; gland flaps wholly adnate, puberulent, the corolla tube conspicuously distended by the apparently functional glands; stamens slightly exserted, 8–12 mm. long, the anthers oblong, 1–1.5 mm. long, the filaments densely villous on their lower ⅔ (stamens included and only 4–5 mm. long in some heterostylic forms); style usually a little exserted in flower, when mature 8–15 mm. long, cleft ⅓ to ⅔, hirsutulous at base, the summit of the ovary hirsute; mature capsule subglobose, 4–6 mm. in diameter; ovules 2 to each placenta; seeds usually 4, ovoid-angled, 3–4 mm. long, black, areolate and finely alveolate.

TYPE LOCALITY: "in sylvis occidentalibus montium *Alleghanis* et Kentucky," *Michaux*.

DISTRIBUTION: Western Virginia to Georgia and Alabama, west to Illinois, Missouri, and northeastern Arkansas, in deciduous woods, frequently on limestone.

REPRESENTATIVE SPECIMENS: **WEST VIRGINIA.** Fayette Co.: Keeney Creek, *Morton 1858* (US). Raleigh Co.: Fitzpatrick, 5 May 1940, *Tosh* (UC). McDowell Co.: Iaeger, 13 June 1907, *Braun* (BRAUN). **VIRGINIA.** Rockbridge Co.: Lexington, 1828–34, *J. Hall* (F). Russell Co.: Cartertown, *Eggleston 17,615* (US). Lee Co.: The Cumberlands, *Carr 929* (GH). **NORTH CAROLINA.** Caldwell Co.: Blowing Rock, *Heller 259* (F, GH, MO, NY, PA, UC, US), *Small & Heller 259* (F, GH, MO, NY, PA, UC, US). Madison Co.: Hot Springs, *Oosting 35,239* (DUKE, GA). Swain Co.: Blowing Springs, *Oosting 35,258* (DUKE, WVA). Polk Co.: Tryon, *Biltmore Herb. 787b* (F, GH, NY, PA, US). **TENNESSEE.** Sullivan Co.: Bristol—Shady Bluff, *Sharp 1455* (TENN). White Co.: Bon Air, *Weatherby & Weatherby 6261* (GH, NY, TENN, US). Polk Co.: Hiawassee Gorge, April 1893, *Kearney* (NY). Franklin Co.: Sewanee, *Svenson 7632* (GH, MO, UC). Cheatham Co.: Kingston Springs, *Palmer 35,518* (GH, MO). **SOUTH CAROLINA.** Oconee Co.: Tomassee Falls, *House 2081* (MO, NY, US). **GEORGIA.** Walker Co.: Pigeon Mt., *Harper 335* (K, NY, US). Dade Co.: Trenton, *Hermann 10,205* (GH, NY, PA, US). **ALABAMA.** Madison Co.: Eason Mt., *Harper 3412* (GH, NY, PA, US). Marshall Co.: Kennamer Cove, *Harper 3414* (GH, PA, US). Colbert Co.: Sheffield, *Harper 3320* (F, GH, NY, PA, US). Perry Co.:

Hamburg, May 1841, *Buckley* (type collection of *P. brevistylis* Buckl., GH, K, MO). **OHIO.** Hamilton Co.: Fernbank, *Short* (GH, PA, UC). **INDIANA.** Cass Co.: Georgetown, *Steyermark 4251* (F). Parke Co.: Clinton, *Deam 27,320* (PA). Franklin Co.: Brookville, *Deam 789* (US). Martin Co.: Loogootee, *Palmer 39,510* (GH, MO). Posey Co.: New Harmony, *Lindheimer 409* (MO). **ILLINOIS.** Putnam Co.: Lake Senachwine, *Chase 4008* (CLOKEY, MO, US). Coles Co.: Embarrass River, *Jones 11,171* (GH). St. Clair Co.: bluffs, 23 May 1875, *Eggert* (MO, NY, US). Jackson Co.: Makanda, 1861, *Vasey* (MO, NY). **KENTUCKY.** Fayette Co.: Elk Lick Falls, *McFarland 104* (KY, MO, US). Harlan Co.: Black Mt., *Braun 358* (BRAUN). Edmonson Co.: Mammoth Cave, May 1899, *E. Palmer* (GH, KSA, NY, US). Union Co.: Grundy Knob, 25 April 1927, *Shacklette* (KY). **MISSOURI.** St. Louis Co.: St. Louis, 29 April 1879, *Eggert* (MO, NY, UC, US). Carter Co.: Big Spring, *Steyermark 7782* (MO, US). Pulaski Co.: Piney River, *Steyermark 7773* (MO). **ARKANSAS.** Independence Co.: Batesville, *Demaree 17,065* (GH, KY, MO, NY, OKL, TENN). **? MISSISSIPPI.** "Mississippi," 1856, *Spillman* (MO).

Because of its prominent glands and their associated scales, *P. bipinnatifida* has heretofore been placed in section *Euphacelia*, where its morphology and distribution make it anomalous, whereas it is thoroughly "at home" in the subgenus *Cosmanthus*. *Phacelia brevistylis* Buckl. ("limestone rocks, Hamburg, Wilcox [Perry] County, Alabama") and *P. bipinnatifida* var. *Plummeri* Wood ("Richmond, I[ndian]a") are based on a variation with sparser pubescence, larger and less divided leaf segments, smaller flowers, and sub-included stamens and style. These variations are not concomitant, and the distribution of forms showing a complete or partial combination of them is sporadic, as indicated by the location of the two type stations. There does, however, appear to be some heterostyly in the species. I am at a loss to understand Rafinesque's description of the fruit of his genus *Endiplus* as, "a double capsul, the exterior one monolocular bivalve hairy; the interior one bilocular bivalve 4-seeded, seeds one above the other." The following year, however, he associated his two species, *E. bifidus* ("Allegheny Mts. or Ohio") and *E. phaceloides* ("pres de Pittsburg, etc.") with *Phacelia bipinnatifida* as probably congeneric. A strikingly distinct species in the genus, *P. bipinnatifida* is more likely to be confused with comparably broad-leafed species of *Hydrophyllum* than with any other *Phacelia*.

12. **Phacelia ranunculacea** (Nutt.) Const. Rhodora **42:** 39. 1940.
Ellisia ranunculacea Nutt. Trans. Amer. Philos. Soc. N. S. **5:** 191. 1837.
Phacelia Covillei S. Wats. ex A. Gray, Man. N. Amer. Bot. ed. 6. 360. 1890.

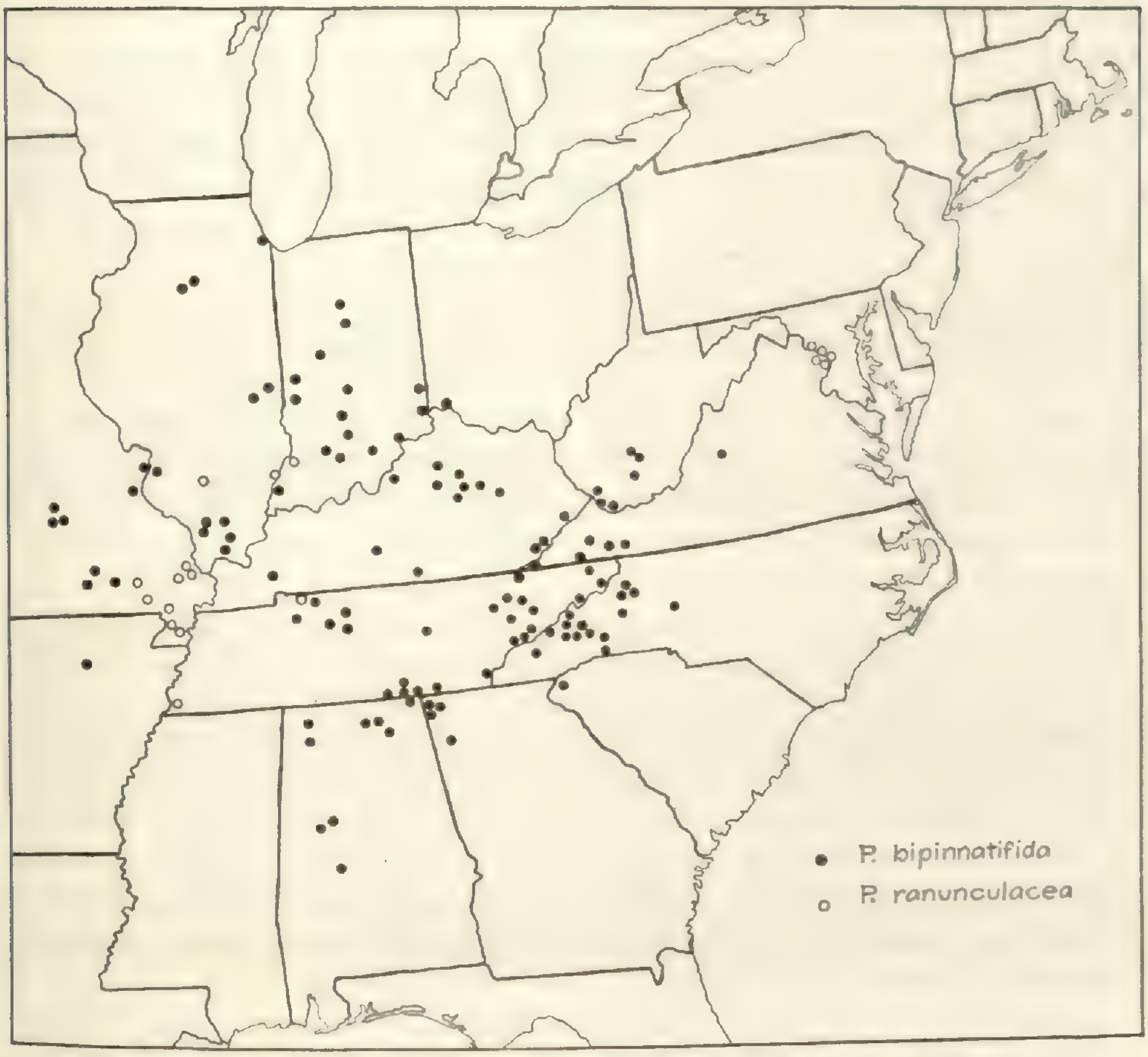


Fig. 7. Distribution of *P. bipinnatifida* and *P. ranunculacea*.

Annual, 5–25 cm. high, simple or branching from near the base, the branches prostrate to erect; stems strigose at base with stiff afflexed hairs, the inflorescence spreading-hirsutulous and -hirsute, sparsely glandular with slender capitate glands; cotyledons persistent in anthesis, ovate to orbicular, purplish, sparsely strigulose above, glabrous beneath; basal leaves petiolate, oblong to ovate, 1–4.5 cm. long, 0.5–2.5 cm. broad, pinnate with remote leaflets to pinnatifid with 1 to 3 pairs of orbicular to oval, toothed or entire leaflets or lobes and a larger obovate trilobed terminal leaflet or lobe, the cauline leaves all petiolate, deeply lobed or pinnatifid with 1–3 pairs of orbicular to lanceolate, entire or toothed, obtuse or acute lobes, strigose on both surfaces; inflorescence weakly scorpioid, of simple terminal, often bracteate, 2–6-flowered cymes, the mature pedicels 5–12 mm. long, spreading-reflexed to pendent; calyx lobes linear-lanceolate, 5–7 mm. long, 0.5–1.5 mm. broad, subequal, acute, strigose on both surfaces and sparsely glandular at base; corolla pale violet or lavender, tubular-campanulate, 3–5 mm. long, 2–4 mm. broad, the lobes oval, entire, glabrous; gland flaps reduced to two minute ridges at the very base of the tube; stamens included, 1.5–2 mm. long, the anthers oval, about 0.3 mm. long, the filaments glabrous; style included in flower, when mature 1.5–2 mm. long, cleft about ½, glabrous, the summit of the ovary hirsute; mature capsule depressed-globose, 4–6 mm. in diameter, markedly distended by the seeds; ovules 2 to each placenta; seeds 2–4, globose-ovoid, 2–2.5 mm. long, brown, finely reticulate.

TYPE LOCALITY: "In the shady humid alluvial forests of the Arkansas, frequent," *Nuttall*.

DISTRIBUTION: Region of the upper Potomac River; southern Indiana to Illinois, Missouri, eastern Tennessee, and (?) northeastern Arkansas, in shaded alluvial soil.

REPRESENTATIVE SPECIMENS: **MARYLAND.** Montgomery Co.: Larkspur Island, 12 May 1889, *Coville* (GH: type of *P. Covillei* S. Wats., NY, US), *Hermann 10,275* (F, MO, PA); Plummers Island, 30 April 1897, *Steele* (DUKE, GH, US, WVA); opposite Larkspur Island, 10 May 1933, *Hermann & Martin* (NY, TENN, US, WVA); Glen Echo, *Constance 3021*. **D. C.** Chain Bridge, *Constance 3018*. **VIRGINIA.** Arlington Co.: Clarendon, *Allard 281* (DUKE, F, GH, KY, MO, NY, US), *4513* (GH, MO, NY, US). **INDIANA.** Knox Co.: Mt. Carmel, *Deam 42,896* (GH, MO, NY, PA, US), *44,032* (GH, US). **ILLINOIS.** Wabash Co.: Cypress Pond, 11 May 1892, *J. Schneck* (NY). Washington Co.: Irvington, 1873, *G. H. French* (US). **MISSOURI.** "Lead mines of Missouri," *James* (NY). Dunklin Co.: Campbell, *Palmer 39,064* (GH). Stoddard Co.: Heazy, *Steyermark 5074* (F, US). **TENNESSEE.** Montgomery Co.: Clarksville, 16 April 1917, *H. Fox* (PA). Shelby Co.: Memphis, 29 March 1846, *Fendler* (MO). **? ARKANSAS.** "In the shady humid alluvial forests of the Arkansas," *Nuttall* (type collection of *Ellisia ranunculacea* Nutt., GH & UC: photo).

Several years ago, I pointed out the identity of *Ellisia ranuncu-*

lacea Nutt. with *Phacelia Covillei* S. Wats. ("Larkspur Island in the Potomac, 5 miles above Washington"). The species has yet to be rediscovered in Arkansas, but since it occurs a short distance across the state line in Missouri and Tennessee, there seems little reason to doubt that it may be detected there. Gray confused this plant with *Nemophila microcalyx* (Nutt.) F. & M., and Steyermark and Palmer (1935) have recently repeated this error in referring to the occurrence of "*Nemophila*" in Missouri. The disrupted or bipolar distribution of the species is rather puzzling. The plant is exceedingly common in wooded alluvial bottoms along the Potomac River above the Fall Line, and is apparently rare west of the mountains. This distribution may perhaps represent the shrunken remnant of one like that of *P. bipinnatifida* or *P. Purshii*, although it has some features in common with that of *Ellisia Nyctelea* L. (Constance, 1940). The tubular-campanulate corolla, vestigial glands, glabrous stamens and style, semi-globose seeds, distended capsule, and peculiar chromosome number make this species rather aberrant in *Cosmanthus*. Its closest affinities are certainly with *Phacelia*, however, and it agrees more closely with the other members of *Cosmanthus* than with any other plants. The alternative treatment of constituting a special group for it does not, in my opinion, offer any particular advantage.

13. **Phacelia Purshii** Buckl. Amer. Jour. Sci. I. **45:** 171. 1843.

Phacelia fimbriata sensu Pursh, Fl. Amer. Sept. **1:** 140. 1814, non Michx. 1808.
Cosmanthus fimbriatus Nolte, Cat. Sem. Hort. Germ. 1838, not as to type.
Cosmanthus pectinatus E. Mey. Ann. Sci. Nat. III. **5:** 366. 1846.
Phacelia fimbriata var. *? Boykini* A. Gray, Proc. Amer. Acad. **10:** 320. 1875.
Phacelia Boykini Small, Bull. Torrey Club **25:** 136. 1898.
Phacelia Bicknellii Small, Bull. Torrey Club **25:** 141. 1898.
Polemonium ciliatum Willd. ex Brand; Engler, Pflanzenr. **4**[251]**:** 62. 1913. (Nomen.)
Phacelia ciliata Raf. ex Brand, op. cit. (Nomen.)

Annual, 10–80 cm. high, simple or branching near the base, erect or ascending; stems strigose with stiff afflexed hairs, the inflorescence strigulose or strigose; basal leaves petiolate, oblong to oval, 1.5–5 cm. long, 1–2.5 cm. broad, pinnate or pinnatifid with 1–3 pairs of oblong to orbicular, entire or toothed leaflets or lobes and a larger 3- or 5-lobed terminal leaflet or lobe, the cauline leaves lanceolate-oblong to ovate, sessile and clasping, deeply pinnatifid with 2–5 pairs of lanceolate to ovate, usually acute lobes, strigose or strigulose on both surfaces; inflorescence of simple terminal

and axillary 10–30-flowered cymes, the mature pedicels spreading-ascending or spreading, 3–22 mm. long; calyx lobes linear to oblong-spatulate, 3–7 mm. long, 0.5–1.5 mm. broad, subequal, acute or obtuse, hirsute-ciliate and usually somewhat strigose or strigulose on one or both surfaces; corolla bluish-violet with a white center, often very pale, subrotate, 5–13 mm. broad, the lobes obovate, fimbriate, glabrous or glabrate; gland flaps wholly adnate, glabrous; stamens usually exserted, 4–7 mm. long, the anthers oblong, 0.8–1.2 mm. long, the filaments densely villous on their lower ½; style included in flower, when mature 4–6 mm. long, cleft ½ to ⅔, glabrous, the summit of the ovary hirsute; mature capsule globose-ovoid, 2–5 mm. in diameter; ovules 2 to each placenta; seeds 2–4, ovoid-angled, 1.5–3 mm. long, brown, areolate and finely alveolate.

TYPE LOCALITY: "in montibus Carolinae et Georgiae," *Buckley*.

DISTRIBUTION: Pennsylvania and Maryland south to Georgia and Alabama, and west to Illinois and eastern Missouri, in alluvial soil in deciduous woods.

REPRESENTATIVE SPECIMENS: **PENNSYLVANIA.** Allegheny Co.: Darlington Hollow, *Shafer 181* (CLOKEY, F, MO, PENN, US). Greene Co.: Jefferson, *Bell 514* (CLOKEY, GH, OKL, PENN, TENN, WVA). **MARYLAND.** Montgomery Co.: Plummers Island, 6 June 1897, *Pollard* (GH, MO, NY, US); Glen Echo, *Constance 3023*. **D. C.** Washington, 22 June 1937, *Kearney* (NY, TENN, US). **WEST VIRGINIA.** Mineral Co.: Burlington, 30 May 1938, *Alexander* (NY). Monongalia Co.: Dent's Run, 4 June 1940, *J. C. Myers* (CLOKEY, NY). Ohio Co.: Wheeling, 26 May 1879, *Mertz* (F, PA, US). **VIRGINIA.** Fairfax Co.: Potomac River, June 1879, *Chickering* (F, US). Wythe Co.: Wytheville, 1 April 1876, *Shriver* (GH, K, US). Smyth Co.: Marion, 22 May 1892, *Small* (F, GH, MO—part, NY, PENN, UC—part, US), *Britton, Britton & Vail* (KSA, NY, PA). **NORTH CAROLINA.** Haywood Co.: Lake Junaluska, *Oosting 37,167* (DUKE). **TENNESSEE.** Sevier Co.: Sevierville, April 1842, *Rugel* (K, NY). Smith Co.: Carthage, *Shanks & Sharp 451* (MO, PENN, TENN). Davidson Co.: Nashville, 12–17 May 1894, *Bicknell* (NY: type of *P. Bicknellii* Small), April–May 1879, *Gattinger* (*Curtiss 2129*) (F, GH, MO, NY, PA, PENN, US), *Eggleston 4420* (GH, MO, NY, PA, US), *Svenson 10,109* (DUKE, GH, MO, PA, TENN, UC). **GEORGIA.** "In montibus Carolinae et Georgiae," *Buckley* (PA: type of *P. Purshii* Buckl., GH). DeKalb Co.: campus, 28 April 1936, *Whitaker* (CLOKEY). Muscogee Co.: Columbus, 1839, *Boykin* (GH: type of *P. fimbriata* var. *? Boykini* A. Gray, K, NY). **ALABAMA.** Madison Co.: Huntsville, 1858, *Nevius* (GH). Tuscaloosa Co.: Warrior River, 1 May 1919, *Harper* (NY, US); North River, 20 September 1932, *Harper* (GH, NY). **OHIO.** Cuyahoga Co.: Bedford, 9 June 1897, *J. R. Watson* (F, KSA, PA, US), *Ashcroft* (F, MO, US). Belmont Co.: Barnesville, *E. E. Laughlin 968* (GH). Hamilton Co.: Cincinnati, 14 May 1890, *Lloyd* (GH, MO). **INDIANA.** Wells Co.: Harrison Township, 24 May 1903, *Deam* (GH, MO, NY, OKL, US). Franklin Co.: Metamora, *McCoy 3747* (DUKE, F, TEX, WVA). Montgomery Co.: Crawfordsville, 1889,

Cooms (KSA, US). Gibson Co.: Owensville, *Kriebel 3801* (DUKE). **ILLINOIS.** "Illinois," *Rafinesque* (PA: basis for *P. ciliata* Raf.?). Vermillion Co.: Danville, May 1909, *Gleason* (GH, PENN, UC). St. Clair Co.: ————, 6 May 1879, *Eggert* (GH, KSA, MO, NY, UC, US). Jackson Co.: Grand Tower, *Gleason 2575* (GH). **KENTUCKY.** Fayette Co.: Lexington, April–May, *Short* (F, GH, KY, PA). Woodford Co.: Versailles, *McFarland* (*Fl. Kentucky 92*) (CLOKEY, DUKE, MO, NY, PENN, TENN, US). **MISSOURI.** St. Louis Co.: Allentown, 1 June 1901, *Letterman* (F, MO, NY, PA, TEX). Jefferson Co.: Pevely, *Lodewyks 116* (MO, US). Reynolds Co.: Piedmont, *Steyermark 22,058* (F).

A beautiful, distinctive, and widely distributed plant, this is probably the best known species of the group, and was the original species of *Cosmanthus* Nolte. It includes *P. fimbriata* var. *? Boykini* A. Gray ("upper part of Georgia") as well as *P. Bicknellii* Small ("near Nashville, Tennessee"), despite some serious errors in Small's descriptions. The two epithets just cited are based upon the same, perhaps ecological (in association with limestone?), variation with smaller flowers, shorter pedicels, and smaller capsules and seeds. The presence of appressed rather than spreading hairs and areolate and alveolate rather than simply reticulate seeds, clearly shows that Gray associated Boykin's plants with the wrong species.

14. **Phacelia fimbriata** Michx. Fl. Bor. Amer. **1:** 134. 1808.

Cosmanthus fimbriatus Nolte, Cat. Sem. Hort. Germ. 1838, as to name only.

Annual, 10–40 cm. high, simple and erect or branching near the base, the branches usually decumbent below; stems very sparsely hirsute with rather stiff spreading or deflexed scattered hairs, often glabrate above, the inflorescence hirtellous (usually on only one side of the stem) and often with some stiff hairs; basal leaves petiolate, oblong to oval, 1.5–3 cm. long, 1–2.5 cm. broad, pinnate or pinnatifid with 1 or 2 pairs of oval or oblong, entire or toothed leaflets or lobes and a larger trilobed terminal leaflet or lobe, the cauline leaves oblong to oval, sessile and clasping, deeply lobed with 2–4 pairs of oblong to oval, usually obtuse lobes, sparsely strigose on the upper surface, paler and often glabrate on the lower; inflorescence of simple terminal 5–20-flowered cymes, the mature pedicels spreading-ascending to pendent, 10–22 mm. long; calyx lobes oblong to oblanceolate, 4–6 mm. long, 0.8–1.2 mm. broad, subequal, usually obtuse, hirsute-ciliate, the surfaces usually glabrous; corolla white or tinged with blue or lavender, subrotate, 5–15 mm. broad, the lobes obovate, strongly fimbriate, glabrous; gland flaps free at the tip, glabrous; stamens barely exserted, 4–6 mm. long, the anthers oblong, 0.8–1.2 mm. long, the filaments densely villous on their lower ½; style included in flower, when mature 3–5 mm. long, cleft ¼ to ⅓, glabrous, the summit of the ovary hirsute; mature capsule globose-ovoid, 4–6 mm.

in diameter; ovules 2 to each placenta; seeds 2–4, ovoid-angled, 3–3.5 mm. long, brown, finely reticulate.

TYPE LOCALITY: "in excelsis montibus Carolinae," *Michaux*.

DISTRIBUTION: Mountains of the Tennessee-Virginia-North Carolina boundary, at elevations of 3,500 to 5,000 feet, in openings in deciduous woods.

REPRESENTATIVE SPECIMENS: **VIRGINIA.** Grayson Co.: Mt. Rogers, 29 June 1892, *Britton, Britton & Vail* (NY). Smyth Co.: White Top Mt., 28–29 May 1892, *Small* (DUKE, F, GH, MO, OKL, PA, PENN, TENN, TEX, UC, US, WVA). Washington Co.: White Top Mt., June 1892, *Britton, Britton & Vail* (UC, US). **NORTH CAROLINA.** Avery Co.: Roan Mt., 1842, *Buckley* (GH, MO, NY), 18 June 1879, *Gray, Sargent Redfield & Canby* (F, GH, PA, PENN), June 1879, *Canby* (F, NY, PA, US). Swain Co.: Indian Gap, 28 April 1948, *Camp* (US). **TENNESSEE.** Carter Co.: Roan Mt., June 1870, *Parry* (GH, NY, US). Sevier Co.: Elkmont, *Jennison 2217* (*Gray. Exsicc. 862*) (F, GH, MO, OKL, PA, PENN, SMU, TENN, TEX, UC, US, WVA).

Although it has been badly confused with *P. Purshii* in the literature and in herbaria, pubescence and seed characters readily permit the recognition of *P. fimbriata* as a distinct species. It is remarkable for its narrow restriction to higher altitudes in the Great Smokies' region. Dr. W. H. Camp kindly made two collections for me near Indian Gap, at an elevation of 5,200 feet. He refers to the habitat as a "rocky woodland with considerable slope," and adds that the species forms dense vernal societies in several of the "beech gaps" before any of the trees expand their foliage. Out of several thousand plants with corollas white except for their "powder-blue" anthers, he selected seven which had "pale, lavender-blue flowers of varying intensities." Although the dried specimens are at once reminiscent of *P. Purshii*, the pubescence is that of *P. fimbriata*. A mixup of the two species would not be at all surprising, but thus far I have seen no convincing evidence of its occurrence.

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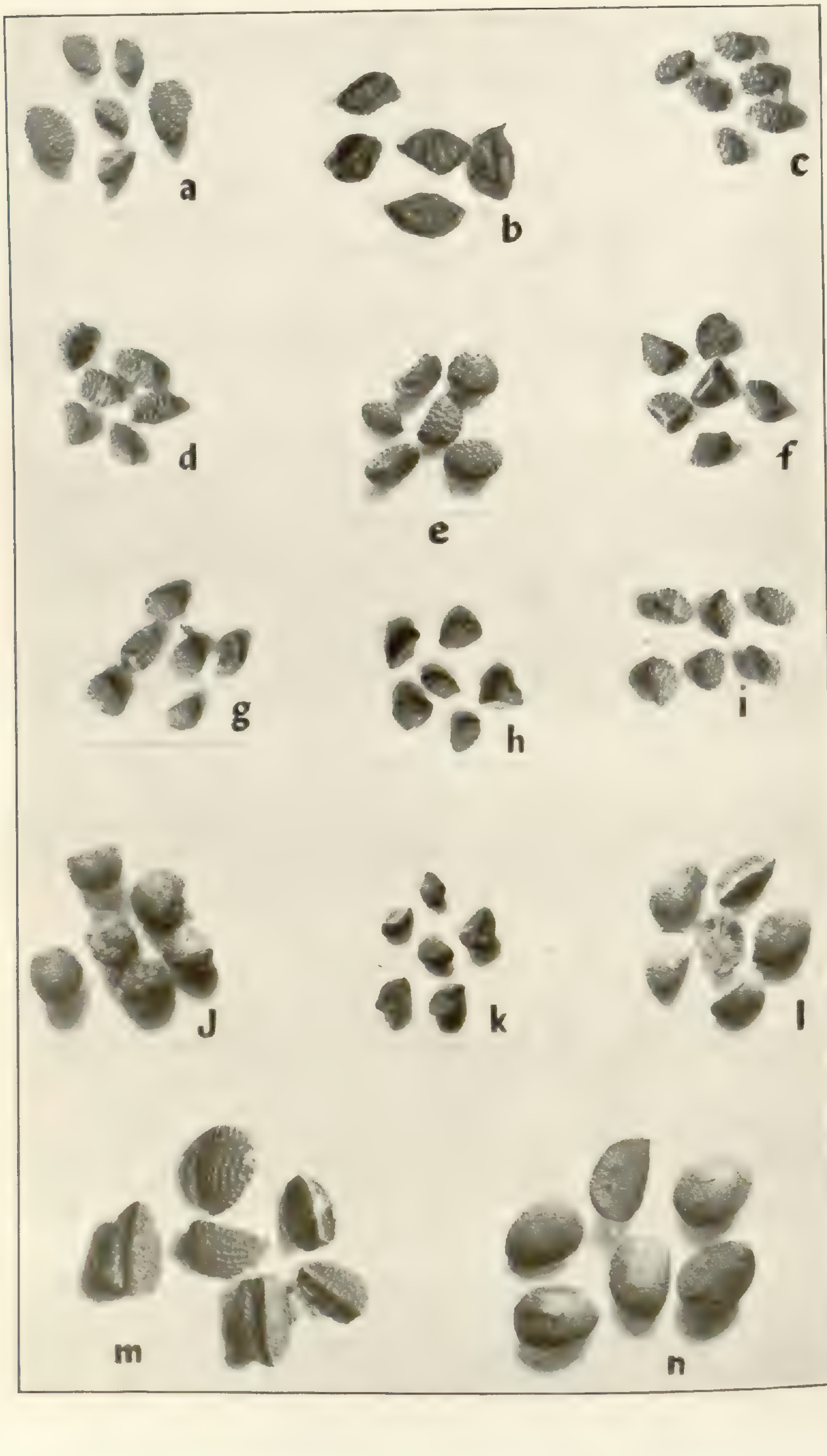
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EXPLANATION OF PLATE

PLATE I. Seeds of *Phacelia* subgen. *Cosmanthus*, all ca. × 2½. Fig. a, *P. platycarpa;* fig. b, *P. pulcherrima;* fig. c, *P. strictiflora;* fig. d, *P. patuliflora;* fig. e, *P. laxa;* fig. f, *P. hirsuta;* fig. g, *P. gilioides;* fig. h, *P. maculata;* fig. i, *P. glabra;* fig. j, *P. dubia;* fig. k, *P. bipinnatifida;* fig. l, *P. ranunculacea;* fig. m, *P. Purshii;* fig. n, *P. fimbriata.*

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CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD UNIVERSITY—NO. CLXIX

Part I. SOME IDENTITIES IN BREWERIA

M. L. Fernald and Bernice G. Schubert

(Plates 1121–1129)[1]

Disturbed by the fact that *Breweria Pickeringii* (Torr.) Gray rests upon a plant from southeastern North Carolina (Wilmington) which was originally described as having the central flower of each "aggregate" inflorescence sessile, whereas the plants of southern New Jersey, western Illinois and adjacent Iowa, and the Oklahoma-Texas region have them pedicelled, the senior author has borrowed from several of the larger American herbaria all the material which has passed as *B. Pickeringii*. The present notes summarize the results of our study of the assembled material from these strikingly disjunct areas and another region not generally included in the stated range. Before entering upon discussion of that species, however, it is important to clear the identities of some earlier described species in order that any references to them may not be misleading.

Breweria aquatica (Walt.) Gray, Syn. Fl. N. Am. ii[1]. 217 (1878), rests nomenclaturally on *Convolvulus aquaticus* Walt. Fl. Carol. 94 (1788), our plate 1121, fig. 1. It has also been called *Stylisma aquatica* (Walt.) Chapm. Fl. So. U. S. 346 (1860) and *Bonamia aquatica* (Walt.) Gray, Man. ed. 5: 376 (1867).

[1] The cost of engraving met through aid from Mr. Bayard Long.

In all Gray's work, as summarized in the Synoptical Flora, he treated *Breweria aquatica* as a catch-all to include all plants of temperate North America in the subgenus *Stylisma* which he did not merge with the very different *B. humistrata* (Walt.) Gray and *B. Pickeringii* (Torr.) Gray. Under *B. humistrata* (our PLATE 1122) he placed the strikingly dissimilar *Convolvulus patens* Desr. (PLATE 1121, FIG. 2) and *C. trichosanthes* Michx. (PLATE 1123), while some specimens labelled by him as *B. humistrata* are of the very distinct *B. angustifolia* Nash (PLATE 1124). Nowadays, however, the name *Breweria aquatica* is generally applied to a plant with style cleft half way to base or still lower, filaments essentially glabrous, flowers mostly 3 in small corymbs, with the short bracts close to the base of the corymb, the pedicels and calyx densely villous (PLATE 1123), a plant which, we shall see, is quite unlike Walter's type. The name *C. trichosanthes* Michaux, as applied by Small, covers a plant very unlike Michaux's type (PLATE 1123, FIG. 1), for Small had a very slender plant, usually with narrower leaves, the solitary flowers long-stalked above the remote bracts, the calyx minutely tomentulose, the filaments villous (PLATE 1121).

It is evident that the types of Walter's *Convolvulus aquaticus*, Michaux's *C. trichosanthes*, Torrey's *C. Pickeringii* and some other types have entered only vaguely into recent interpretations. Walter's *C. aquaticus* was more fully described by him than many of his species:

> *aquaticus* 9. caule tereti prostrato; foliis, petiolis brevibus, oblongis, nervo acuminatis, pubescentibus, alternis; pedunculis axillaribus, unifloris, folia aequantibus; bracteis duabus subulatis; calyce pentaphyllo tomentoso; floribus brevibus, rubro-purpureis, tomentosis; stylo bipartito, capsula villosa.

Fortunately the Fraser scrap-book of fragments of Walter's plants contains definitely a "scrap" of *Convolvulus aquaticus*, no. 231 on p. 36 (our PLATE 1121, FIG. 1, × ½). This, so far as it goes, is identical with *C. patens* Desr. in Lam. Encycl. iii. 547 (1789), a portion of the TYPE of which is shown, × 1, in PLATE 1121, FIG. 2. This type-sheet had previously been shown by

Fernald in RHODORA, xlii. t. 624, fig. 1 (1940). Walter's fragmentary type and the fuller one of Desrousseaux are readily matched by many specimens from the southeastern United States, such as *Wiegand & Manning*, no. 2632 from Liberty County, Georgia, our FIG. 3, this, like many other similar collections, distributed as *Breweria trichosanthes* sensu Small. We are, somewhat inconveniently, forced to make the following change:

BREWERIA AQUATICA (Walt.) Gray, Syn. Fl. N. Am. ii[1]. 217 (1878), as to basonym only. *Convolvulus aquaticus* Walt. Fl. Carol. 94 (1788). *Conv. patens* Desr. in Lam. Encycl. iii. 547 (1789). *Stylisma aquatica* (Walt.) Chapm. Fl. So. U. S. 346 (1860), as to basonym only. *Bonamia aquatica* (Walt.) Gray, Man. ed. 5: 376 (1867), as to basonym only. *Breweria trichosanthes* sensu Small, Fl. Se. U. S. 959 (1903), not *Conv. trichosanthes* Michx., basonym. *Stylisma trichosanthes* sensu House in Bull. Torr. Bot. Cl. xxxiv. 148 (1907), not *Conv. trichosanthes* Michx., basonym. *Breweria patens* (Desr.) Fernald in RHODORA, xlii. 298, pl. 624 (1940). PLATE 1121.

As already pointed out by the senior author in RHODORA, l. c. the type of *Convolvulus trichosanthes* Michx. Fl. Bor.-Am. i. 137 (1803), our PLATE 1123, FIG. 1, × ½, therefore of *Breweria trichosanthes* (Michx.) Small, as to basonym only, is the plant which has been erroneously passing as *B. aquatica*. As indicating this identity a characteristic piece of a modern specimen, × 1, (from Miami, Florida, *Curtiss*, no. 5855) and some enlarged details from other specimens, × 5, are shown as figs. 2–4). Michaux's description and preserved TYPE are unequivocal; but, unfortunately, his specific name is illegitimate, since he cited as exact synonyms the two earlier species of Walter (1788), "*C. humistratus* et *aquaticus*. WALT." It is, therefore, necessary to use a different binomial; and since Michaux so clearly described his plant and left so characteristic a type we are calling it

BREWERIA **Michauxii,** nom. nov. *Convolvulus trichosanthes* Michx. Fl. Bor.-Am. i. 137 (1803), nom. illegit.; Fernald in RHODORA, xlii. 298 (1940). ? *Stylisma elliptica* Raf. N. Fl. N. Am. pt. iv. 55 (1838), not *B. elliptica* Smith & Schubert in Contrib. Gray Herb. cxxvii. 31, pl. 2, figs. 31 and 32 (1939). *B. trichosanthes* (Michx.) Small, Fl. Se. U. S. 959 (1903), as to basonym only, not as to plant described. *Stylisma trichosanthes* (Michx.) House in Bull. Torr. Bot. Cl. xxxiv. 148 (1907), as to basonym only, not as to plant described. *B. aquatica* sensu most Am.

auth., not as to basonym, *Convolvulus aquaticus* Walt. Plate 1123.

From the synonymy given by House in his study of *Stylisma*, Bull. Torr. Bot. Cl. xxxiv., especially p. 149 (1907), under *S. aquatica* in his sense, *i. e.* our *Breweria Michauxii*, one would infer that there are two names available for this species. The first, *Convolvulus erianthus* Willd. ex Spreng. Syst. i. 610 (1825), described "C. foliis linearibus elongatis basi attenuatis nudiusculis, . . . pedunculis elongatis 1 floris", etc. can hardly be our plant, which has the very pubescent elliptic-oval to oblong leaves broadly rounded to cordate at base and the peduncles mostly 3-flowered. Until the type of Willdenow's species can be studied it would be futile to guess what he had. House also cites as belonging to this species *Stylisma elliptica* Raf. "Fl. Tellur. **4**: 55. 1836". Obviously House did not closely inspect Rafinesque's account, for the species is not in Flora Telluriana (pt. 4 published in 1838) and p. 55 was occupied by generic and subgeneric segregates of Old World *Veronica*. In his New Fl. N. Am. pt. 4 (1838) Rafinesque described his *Stylisma elliptica* on p. 55. It is quite possible that Rafinesque had *B. Michauxii*, for his "leaves petiolate elliptical hardly pubescent, base subcordate, end obtuse mucronate" is rather definite for it (except "hardly pubescent") but "calix smooth" is not at all good for a closely pubescent calyx. This character and the "hardly pubescent" leaves immediately suggest *B. humistrata*. At any rate, the name cannot be taken over into *Breweria* because of the large-flowered Mexican *B. elliptica* Smith & Schubert (1939).

Now coming to the amazingly disjunct series known as *Breweria Pickeringii*, it is a somewhat striking fact that the type and few extant specimens of the original *Convolvulus Pickeringii* Torr. in M. A. Curtis in Bost. Journ. Nat. Hist. i. 129 (1835) seem not to be matched by any other collection nor has anything conspecific with it been found in the type-area, the famous and much explored region of Wilmington, North Carolina. Both *B. angustifolia* (plate 1124) and true *B. aquatica* (plate 1121), misidentified as *B. Pickeringii*, have been collected farther up the valley of Cape Fear River; but Curtis stated that "Most of the species enumerated inhabit a circle around this place [Wilmington] of about two miles radius". In 1830 the population of

Wilmington was about 3000; now it is about twelve times that number, with a considerable summer increase, and its longest diameter is 5 miles. That may account for the lack of recent collections. Even the connection with the Wilmington plant (collected by Moses Ashley Curtis) of Dr. Charles Pickering is a bit obscure. The species, as *Convolvulus Pickeringii*, was published in the *Catalogue of Plants growing spontaneously around Wilmington, North Carolina*, from a manuscript received in September, 1834. In his introductory pages Mr. Curtis said (p. 86): "In preparing the Catalogue I have been kindly assisted by Dr. Torrey, whose name will at once ensure confidence in its general accuracy. To him have been communicated nearly all the doubtful and new species, and they have received numerous corrections and references." There is also acknowledgment of help from Dr. James F. McRee, but nothing about Pickering. On p. 105, under *Convolvulus*, there is an entry "Pickeringii. Tor. (26)", this indicating that Torrey was author of the name, and in the "Remarks on several Plants in the Catalogue" no. 26 (p. 129) is as follows:

> (26) *Convólvulus Pickeríngii.* Prostrate, villous; Leaves linear, 12–15 lines long, one line wide, obtuse, not mucronate; Peduncles longer than the leaves, 3 flowered; Flowers aggregate at the summit, two of them pedicelled in the axis of the leaves that exceed the flowers, with linear bracts at the base of the calyx which equal the flowers, the other sessile and without bracts. The upper peduncles become 2 and 1 flowered. Calyx very villous. Corol hairy, white; style 2 cleft a little below the summit, the parts unequal; Stigmas capitate. Hab. sandy barrens. Flowers June.
>
> Allied to C. patens, but clearly distinct. First noticed by Dr. Pickering, to whom it is dedicated.

The original material sent to Torrey had Curtis's comment: "Nearer C. trichosanthes, var. patens Ph. than Elliott's C. aquatica?". In the remark of Torrey (or perhaps Curtis) at the end of the description there is the clue to the origin of the specific name. Charles Pickering had collected the New Jersey variety six years earlier, the label (in his own hand) of his specimen in Herb. Phil. Acad. reading:

> (capsule one-seeded!)
> 4 miles from Quaker Bridge N. J.
> Aug. 1828. C. Pickering

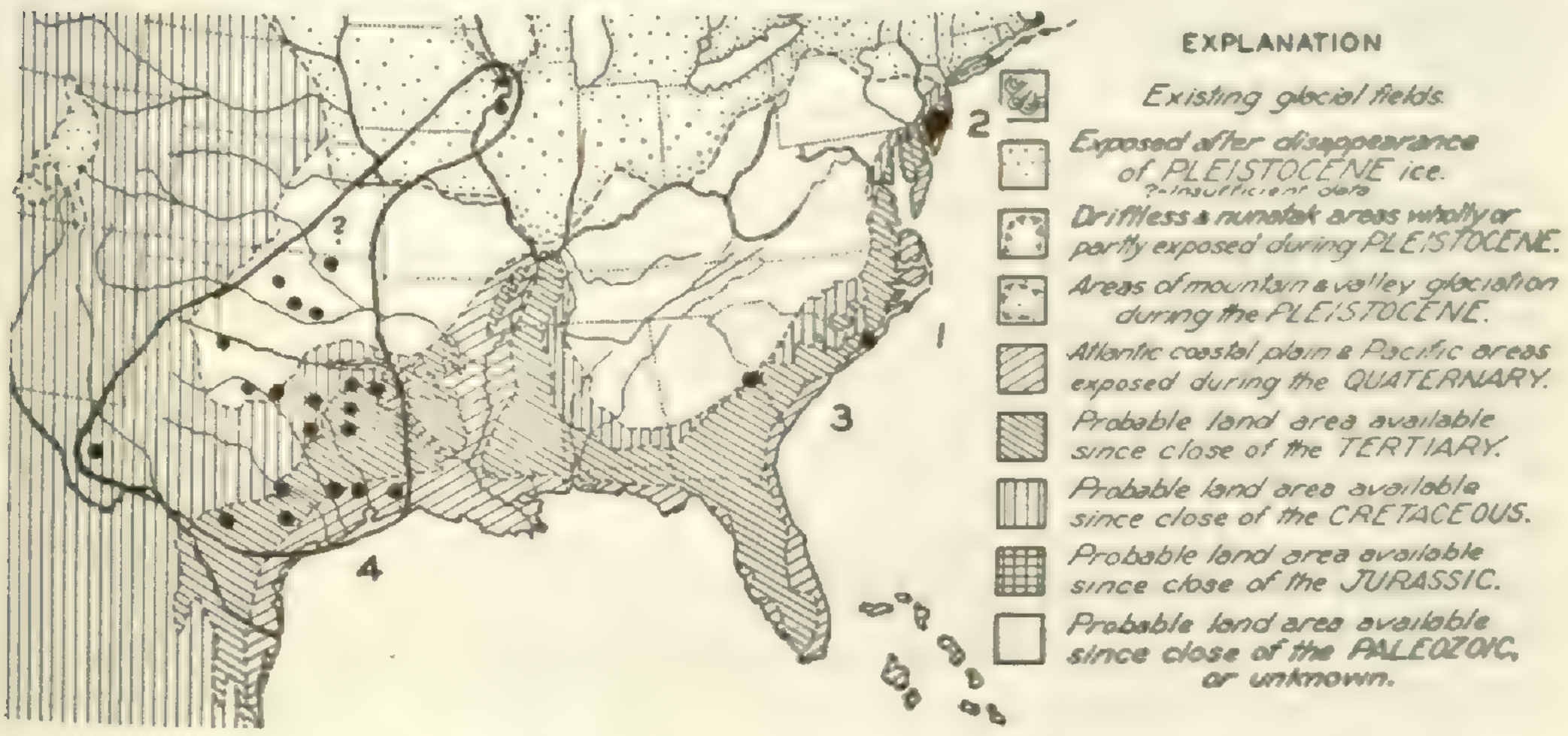
A portion of this Pickering specimen, characteristic for New Jersey, is shown in PLATE 1126, FIG. 1. That it superficially resembles *Convolvulus patens;* i. e. true *B. aquatica* (PLATE 1121, FIG. 2) is obvious, but it has elongate foliaceous bracts, shorter and blunter sepals and (when adequate material is examined) less deeply divided styles. Although the name *Pickeringii* was based on the New Jersey plant, the detailed description and the locality (Wilmington) of the Curtis plant (PLATE 1125) indicate that as the TYPE of the species. It is singular that Torrey did not enter the name on what is obviously the TYPE-sheet. In DC. Prodr. ix. 450 (1845) *Convolvulus Pickeringii* was called *Stylisma evolvuloides* Choisy, β. *angustifolia* Choisy, although the specimen seen was "comm. a Gray!", who had collected the New Jersey plant only. Incidentally, Choisy's *S. evolvuloides* could not have been more inclusive: made up of *Convolvulus humistratus* and *aquaticus* Walt., *C. patens* Desr., *C. tenellus* Lam. and *C. trichosanthes* Michx.!

As we interpret *Breweria Pickeringii*, the aggregate species (MAP 1) is characterized by its very narrow linear or linear-oblanceolate leaves; elongate peduncles bearing 1–3 (rarely–5) flowers, each inflorescence subtended by a pair of elongate bracts similar to the foliage-leaves, the densely pubescent broad sepals blunt or in two varieties pointed, the style shallowly cleft to barely notched or subentire. The remarkable disruption of range has resulted in the local fixity of some characters, although in the aggregate these isolated varieties have the most significant characters much alike. Typical *B. Pickeringii* (PLATE 1125), the plant of Wilmington, North Carolina, has the pubescence of branches, pedicels and sepals densely villous; the central flower of each small corymb or the single flowers sessile; the 2 lateral flowers of the 3-flowered corymbs on pedicels only 1–4 mm. long and 2-bracted at summit, the longer of the unequal branches of the style 2–3 mm. long.

Isolated from it, about 400 miles to the north, is the variety (PLATES 1126 and 1127) found locally in the Pine Barrens of New Jersey. Like typical *Breweria Pickeringii* in habit, foliage, pubescence, blunt sepals and style (except that the 2 branches may often be subequal), it has the single flower or the central one of 2–5-flowered corymbs raised above the bracts on a definite

pedicel and the pedicels of the lateral flowers 0.5–1.5 cm. long. This localized plant we are calling var. *caesariensis*.

Near the fall-line, on the Savannah River, more than 250 miles southwest of Wilmington, the late Alfred Cuthbert collected on the sandhills near Atlanta, Georgia, a plant (PLATE 1128) which looks like *Breweria Pickeringii*, var. *caesariensis*, having the flowers all pedicelled, the lateral ones with pedicels up to 1.5 cm. long, but the sepals, instead of being blunt, are acuminate, a character suggesting *B. angustifolia* (PLATE 1124),



RANGES OF (1) BREWERIA PICKERINGII, var. ANGUSTIFOLIA; (2) var. CAESARIENSIS; (3) var. CUTHBERTII; (4) var. PATTERSONI.

but var. *Cuthbertii* has the elongate foliaceous involucre and involucels (FIG. 2) and the only slightly cleft style of *B. Pickeringii*, with which Cuthbert originally identified it.

These three varieties of the Atlantic states form a consistent series, marked by the positively cleft style (with longer branch 2–3 mm. long), sepals blunt (except in the little known var. *Cuthbertii*) and the villosity tending to be fulvous. Farther west and still more isolated from the plants of southeastern North Carolina and of New Jersey there is a very strongly marked variety (PLATE 1129) with all the characters of the Atlantic series, except for a more canescent and closer pubescence, acute or acutish sepals (as in var. *Cuthbertii*) and, most marked of all, styles subentire or very shallowly cleft, with the longer branches rarely 1 and very rarely 1.5 mm. long. The difference in the branching of the style is the most significant, the acute or acutish

sepals less so, and the canescence of the pubescence probably a long-time response to more inland environment. We are, therefore, looking upon this more western plant as a far-isolated and itself bicentric variety, the larger area in Texas and Oklahoma, the smaller on dry prairies of Muscatine County in southeastern Iowa and of adjacent Henderson County, Illinois. It thus approaches the northeastern corner of Missouri, a state from which it is not reported (doubtless Missourians would not admit that they have land sterile enough for it). This distinctive plant of dry prairies we are naming for the keen botanist of Henderson County, Illinois, the late Harry N. Patterson, whose model specimens are found in most of the herbaria studied.

B. Pickeringii (Torr. in M. A. Curtis) Gray, var. **angustifolia** (Choisy), comb. nov. *Convolvulus Pickeringii* Torrey in M. A. Curtis in Bost. Journ. Nat. Hist. i. 105 and 129 (1835). *Stylisma evolvuloides* Choisy, β. *angustifolia* Choisy in DC. Prodr. ix. 450 (1845). *Bonamia Pickeringii* (Torr.) Gray, Man. ed. 5: 376 (1867). *Breweria Pickeringii* (Torr.) Gray, Syn. Fl. N. Am. ii[1]. 217 (1878).—Characterized by its villous and rather fulvous pubescence; peduncles with linear or linear-oblanceolate foliaceous paired bracts at summit; flowers 3 in a close corymb or on the terminal shoots solitary, the central one sessile, the lateral ones on pedicels only 1–4 mm. long; sepals obtuse; style distinctly 2-cleft, the longer branch 2–3 mm. long.—Known only from the type-collection, from dry sand, Wilmington, North Carolina, June, 1834 (type) in Torrey Herb. (N. Y. Bot. Gard.), isotypes in Herb. Mo. Bot. Gard. and Herb. Phil. Acad. Plate 1125.

Var. **caesariensis,** var. nov., a var. *angustifolia* differt floribus 1–5, omnibus pedicellatis, pedicellis lateralibus 0.5–1.5 cm. longis.—Dry sandy woods and openings, local, Pine Barrens of New Jersey. Type: along Mullica River southwest of Batsto, August 21, 1910, *Bayard Long* in Herb. Phil. Acad. Plates 1126 and 1127.

Var. **Cuthbertii,** var. nov., a var. *caesariensi* differt sepalis acuminatis.—Georgia: sandhills, Augusta, June 29, 1901, *Alfred Cuthbert,* type in Herb. N. Y. Bot. Gard. Plate 1128.

Var. **Pattersoni,** var. nov., caulibus pedicellis calycibusque plus minusve cinereo-pubescentibus; floribus pedicellatis; sepalis acutis; stylo subsimplice, subintegro vel breviter diviso, ramo longiore rariter 1 vel 1.5 mm. longo.—Dry sandy prairies, Henderson County, Illinois and Muscatine County, Iowa; more frequent in Oklahoma and widespread in eastern and southern Texas.[1]

[1] In the United States National Herbarium there is a sheet from the Department of Agriculture bearing the data "Kansas, E. A. Papinoe, 1875". Otherwise we know of no evidence of the plant in Kansas.

TYPE: prairies near Oquawka, ILLINOIS, August, 1873?, *Harry N. Patterson* in Herb. Patterson, Chicago Nat. Hist. Mus. PLATE 1129.

In this study we have had the advantage of seeing the material in the following herbaria, besides that in the Gray Herbarium: New York Botanical Garden; Academy of Natural Sciences of Philadelphia; United States National Herbarium; Duke University; State College of University of North Carolina, Raleigh; Chicago Natural History Museum; Missouri Botanical Garden; and University of Oklahoma (including a fine series of freshly collected specimens). To the officials of these institutions who have aided us by these loans we express our thanks and appreciation. Without these loans we should have remained in the dark regarding the original Curtis material and the unique var. *Cuthbertii*.

PART II. STUDIES OF EASTERN AMERICAN PLANTS

M. L. FERNALD

1. BLACKBERRIES, OLD AND NEW (PLATES 1130–1132)

RUBUS ALLEGHENIENSIS Porter, forma **suffultus,** f. nov. (TAB. 1130, FIG. 1), racemis valde bracteatis, bracteis 6–15 pedicellos plerumque superantibus.—Locally abundant in New England. The following are characteristic. NEW HAMPSHIRE: abundant in large colonies, Shelburne, *Fernald & Pease*, no. 15,738 (distrib. as var. *Gravesii* because essentially without prickles); border of dry woods, Shelburne, *Fernald & Pease*, no. 15,763; damp thickets, borders of woods and roadsides, Thornton Gore, *Fernald*, nos. 15,655, 15,700, 15,749 (TYPE in Herb. Gray.; ISOTYPE in Herb. New Engl. Bot. Cl.), 15,820; dry open sandy soil, Haverhill, *Fernald*, no. 15,771. MASSACHUSETTS: Beverly, 1886, *Asa Gray;* Ayer, May 30, 1934, *Ordway & Bullard;* roadside thicket, West Brookfield, July 9, 1935, *C. H. Knowlton;* dry roadside, Konkapot Valley, New Marlboro, July 24, 1912, *Ralph Hoffmann*. CONNECTICUT: below "Indian Burying Ground", Franklin, June 18, 1915, *R. W. Woodward;* Bristol, "a freak", *Blanchard*, no. 97, set 5; Southington, *Blanchard*, no. 97, set 3.

Although called by Blanchard "a freak", forma *suffultus* is, where I have well known it in the Franconia and the Androscoggin regions of New Hampshire, an abundant and very obvious and consistent plant of recent clearings and borders of woods.

Plate 1130, fig. 1 shows the extreme development of racemes, much prolonged and with most of the pedicels subtended by simple overtopping bracts; but clear transitions to more typical *R. allegheniensis* occur. Thus, on no. 15,655 the upper racemes have 9–11 bracts but lower on the cane the lateral racemes are those of typical *R. allegheniensis*, with only 1–5 bracts. Forma *suffultus* suggests Bailey's illustration in Gent. Herb. v. 12, fig. 3 (1941) of a "novirame"; but the bracteate inflorescences of forma *suffultus* are the regular racemes of floricanes, not "novirames" on the primocanes!

R. allegheniensis, forma **calycosus** (Fernald), stat. nov. *R. nigrobaccus*, var. *calycosus* Fernald in Rhodora, iii. 234 (1901). *R. allegheniensis*, var. *calycosus* (Fernald) Fernald, l. c. x. 51 (1908); Bailey, Gent. Herb. v. fig. 232, E (1944).

I am holding *Rubus allegheniensis* in its inclusive sense for the relatively coarse, erect to high-arching species with velutinous lower leaf-surfaces, cylindric racemes mostly 1–3 dm. long and with stipitate glands numerous on rachis and pedicels. In so doing I heartily indorse Bailey's sensible attitude of 1902 in Cycl. Am. Hort. iv. 1578, when he wrote: "No end of species could be made, but it is doubtful whether a great multiplication of species-names would contribute anything more than confusion to the literature and knowledge of the genus" and (p. 1582) "There seems to be little utility in separating forms that cannot be distinguished in at least a fair proportion of the specimens". I cannot, however, wholly indorse the reverse attitude now so much in evidence because altogether too many minor variants and clones are being put out as "new species", for the author of the conservative and wholly safe doctrine of 1902 wrote in 1925 of "aberrants" which "may be species, nascent species, or kinds of nonconformities" and then went on to assure us that his "new species" are not necessarily true or conventional species after all:

> "It will be understood, therefore, that when I write 'new species' (or *species nova*) I do not use the term in its old formal final sense; I am thinking of a congeries of plants so harmonious within itself and so distinct from all others as to require name and diagnosis if we are to discuss the subject intelligently; and I regret that modern practice has not given us a word of clearer accuracy and significance". —Gent. Herb. i. 205 (1925).

Some of the terms for minor variants which were used by

Ascherson & Graebner or the terms variety, subvariety, forma, forma biologica, forma specialis and individual or clone were available. Bailey, l. c., was opposed to throwing "them loosely or uncritically into some recognized species: this extends the confusion". But perhaps much that has been published on the group can hardly escape the tag, "uncritical"; at least it has often indicated "confusion".

To me there is no satisfaction, after many days of struggling with them, in trying to separate from *Rubus allegheniensis* (*R. nigrobaccus* Bailey) such selected and surely intergradient nearly *conformist* plants of Bailey, Gent. Herb. v. fasc. viii (1944) as *R. auroralis* (pp. 525, 526), *R. longissimus* (pp. 527, 528), *R. virginianus* (pp. 532, 533), *R. separ* (pp. 532, 534 and 535), *R. uber* (pp. 535 and 536), and *R. marilandicus* (pp. 537, 538); nor can I see anything more than a useless synonym in the name *R. Rappii* Bailey in Hanes, Fl. Kalamazoo Co., Mich. 156, fig. 14 (1947). To be sure, *R. longissimus* is distinguished, among other inconstant characters, in the key by "broad short obovate leaflets at base" of the "cluster 20 cm. long", but the bracteal leaflets shown in fig. 230 of characteristic *R. allegheniensis* are much more obovate, while, if they are significant, plenty of New England specimens with racemes up to 3 dm. long could be made to glorify all the sisters, cousins and aunts of the chance collectors. Furthermore, by the key *R. allegheniensis* comes under "Prickles on primocane axis many", while *R. virginianus* has "Prickles on primocane very few or none". Nevertheless, comparison of the figure of *R. allegheniensis* (fig. 230) and that of *R. virginianus* (fig. 240) shows about 13 small prickles on 14 cm. of primocane of the former ("Prickles . . . many") but 14 on 17 cm. of primocane of the latter ("Prickles . . . very few or none"). That seems like a pretty vague "specific" difference.

Again, I find myself equally puzzled (and others must be similarly so) by other reputed species of the § *Alleghenienses*. Under "B" in the key in Gent. Herb. v. 509, 510 (1944) *Rubus Rosa* Bailey and *R. alumnus* Bailey come under "Primocane leaflets . . . cordate", while *R. apianus* is under "BB. Primocane leaflets . . . not cordate, narrow or tapering to base . . . ". Unfortunately, however, the would-be interpreter notes that the terminal primocane-leaflet of the last "species" is shown in fig.

252 as broadly ovate and somewhat cordate. Its apex is not quite so prolonged as shown for *R. Rosa* but the difference between this leaflet and the terminal "cordate" one shown for *R. alumnus* is scarcely evident.

As Bailey so forcefully stated in 1902, the designation of many trends as species can contribute nothing "more than confusion to the literature and knowledge of the genus". If he joined the once aggressive group of "mutationists" who saw a species in every clone and hybrid in *Oenothera* he could add still further "confusion"; or if he tackled *Carya* he could find hundreds of his "species" in every hickory-forest, for it is never safe to collect as one number specimens from two adjacent trees! "There seems to be little utility in separating forms that cannot be distinguished in at least a fair proportion of the specimens". Incidentally, it should not be overlooked that, nowadays, when Bailey calls a plant a "species", he does "not use the term in its old formal final sense". If he were an anthropologist what would he do with *Homo sapiens?*

§ *Alleghenienses* is well defined in Gent. Herb. v. 507 (1944) as "Gland-bearing highbush . . . brambles, . . . often very stout . . . inflorescence typically a long racemiform cluster with continuing axis . . . ; rachis of inflorescence, pedicels, usually the calyx, as mostly also the petiolules and parts of petioles, bearing stalked glands". That defines a well marked and generally understood section. It is, therefore, more than a bit perplexing to find in recent publications proposed new species, designated as belonging to the *Alleghenienses*, which patently lack these distinctive characters and as definitely display the significant characters of other defined and generally recognized sections. As striking and as disconcerting as any is *Rubus Bigelovianus* Bailey, l. c. iii. 255 (1934) and v. 558, fig. 245 (1944), a plant with the aspect, slender and bristly canes, essential lack of glands, cuneate floricane-leaflets, and inflorescence and fruits of § *Setosi;* for this very characteristic section is described, l. c. 129, as "plants, of small size . . . characterized . . . by setose or stouter . . . armature on canes and pedicels and by rather short inflorescence that is likely in infrutescence to become as broad as long and cymiform . . . : floricanes often lopped or prostrate even though primocanes may be erect . . . , seldom

much more than about 80 cm. tall, . . . flowers small, commonly with narrow well separated petals: fruit small, usually acid and not pleasantly edible".

Rubus Bigelovianus, collected while Bailey was looking for *R. setosus* Bigel. in the general type-area, Sudbury, Massachusetts, and named for Jacob Bigelow, "commemorated his visit to Sudbury", presumably referring to the collection of *R. setosus* in June, 1823. Otherwise it would be most difficult to say what visit was commemorated, for Jacob Bigelow pleased his parents by making his first recorded "visit" at his birth in Sudbury on February 27, 1787, and his home was in Sudbury until he took up medical practice in Boston, his parents still continuing to reside at Sudbury[1].

RUBUS ALLEGHENIENSIS Porter, var. **populifolius,** var. nov. (TAB. 1130, FIG. 2), a var. typica differt foliolis vel laminis bracteatarum elliptico-ovalibus vel subrotundatis obtusis 2.5–5 cm. longis latisve.—MASSACHUSETTS: border of woods, Stockbridge, July 16, 1916, *Ralph Hoffmann* (TYPE, 3 sheets, in Herb. New Engl. Bot. Club).

In the strongly rounded blades and leaflets of the bracteal leaves var. *populifolius* at once suggests *Populus tremuloides* and by some might be called a distinct species. Its primocane, however, has very characteristic leaves of typical *Rubus allegheniensis*, the long-petiolulate median and terminal long-acuminate leaflets cordate-ovate. The specimens were sent in as *R. Andrewsianus* Blanchard but they have the heavily stipitate-glandular petioles, petiolules, rachis and pedicels and the elongate raceme of *R. allegheniensis*.

Rubus Andrewsianus is one of the fifteen or twenty minor variants of *R. pensilvanicus* Poir. (1804) which have been designated as "species", a score which could be vastly multiplied if collections were made and named from tens of thousands of other burns and recent clearings. *R. pensilvanicus* and its host of minor variants belong to the series under § *Arguti*, which is characterized by lack of glands and by a corymbiform inflorescence. As an aggregate of minor trends, occurring through much of temperate eastern North America, it includes not only *R. Andrewsianus* but *R. philadelphicus* Blanchard, *R. pergratus*

[1] See GEORGE E. ELLIS. Memoir of Jacob Bigelow, Cambridge, 1880. Incidentally, see Fernald in Proc. Am. Phil. Soc. lxxxvi. 68 (1942).

Blanchard and many others. If anyone is skeptical, let him look at four plates in Gent. Herb. v: figs. 315 and 316 (*R. pensilvanicus*), 319 (*R. Andrewsianus*) and 321 (*R. philadelphicus*). Then, if he finds *specific* or any significant differences, let him illuminate those of us who have wasted many days in searching for them.

To be sure, the key (pp. 610 and 611) puts *Rubus pensilvanicus* under "Axis or peduncle of flower-cluster and the pedicels armed with stout thick-based strongly curved or hooked prickles", while *R. Andrewsianus* is under a contrasting "Axis or at least the peduncle of flower-cluster and the pedicels naked, or the prickles, if any, few and weak and not broad-based nor hooked". Nevertheless, the TYPE of *R. pensilvanicus*, as shown in the photograph sent to me from Paris, shows 16 of the 25 pedicels which are clearly visible quite without prickles, this type shown in Bailey's fig. 315, while the fruiting branchlet "a" shown by him as representative of this species, distinguished by "pedicels armed with stout thick-based strongly curved or hooked prickles", has all the pedicels shown as unarmed! In the figure (319) of *R. Andrewsianus* one can count 8 slightly armed pedicels, while in Blanchard's "set 1" from "type sta." in the Gray Herbarium several pedicels have two hooked prickles up to 2 mm. long. Again, try the illustration of *R. philadelphicus* (fig. 321). By the key (pp. 610 and 611) *R. pensilvanicus* and *R. Andrewsianus* have the "Floral leaflets and simple leaves (in the flower-cluster) . . . decidedly acute to acuminate or attenuate", those of *R. philadelphicus* "obtuse or only briefly abruptly acute". Nevertheless, there seems to be no definable difference in the tips of the leaflets as shown, for in "a", under *R. pensilvanicus*, the bracteal leaves and leaflets are shown as scarcely different from those of the others. If these are really different species they have successfully hidden their distinctive characters and they are, at best, "nascent species, or kinds of nonconformities not yet accounted for in our philosophies" (Gent. Herb. i. 205), reminding one of the simple and ungarnished yankee philosophy of Blanchard when he wrote, regarding another species: "The plants at all these stations differ a little from each other, but even at the type station a difference in soil and surroundings causes a considerable variation. This is to be expected nearly everywhere in the rose family"—Blanchard in Torreya, vi. 120 (1906).

Blanchard, of course, did not take into account Poiret's *R. pensilvanicus*, for, accepting the verdict of Index Kewensis, everyone supposed, until I secured a photograph of Poiret's type, that his species was "*R. strigosus*"!

As for *Rubus pergratus* Blanchard in Rhodora, viii. 96 (1906), that characteristic plant of southeastern Canada and New England, where its fruit is highly esteemed, seems to be a strong and large-fruited development of *R. philadelphicus*, with no clear morphological differences. As defined by Blanchard it has the primocanes bearing prickles which are "strong, stout, 2 to 8 to the inch of stem,"—the leaves pubescent beneath, the flowering shoots more or less pubescent, "even woolly on some"; *i. e.* it belongs in the § *Arguti*, which is defined by Bailey (Gent. Herb. v. 46) under "Leaves (and other parts) variously pubescent . . . prickles usually abundant, mostly hooked or bent or at least broad-based". But, for some reason not clear to others, *R. pergratus* has disappeared from his treatment of the *Arguti* and is placed under the § *Canadenses*, this section properly defined (l. c.) as having "Leaves essentially smooth . . . : canes without prickles or with only few and weak straight ones". This plant, with leaflets velvety to touch beneath, with stout hooked prickles and with a corymbiform inflorescence, has suddenly appeared, not only in § *Canadenses*, but under *R. canadensis* itself ("known by its thin usually glossy smooth foliage [by "smooth" meaning glabrous] . . . and in typical forms by its nearly or quite unarmed canes: . . . inflorescence . . . the primary narrow long-racemiform clusters") as *R. canadensis*, var. *pergratus* (Blanchard) Bailey, l. c. v. 470 (1944), with "Leaves soft-pubescent to the finger underneath, therefore gray and the lateral ribs more or less obscured", overlooking the strong prickly canes, the corymbiform inflorescence, etc. If the characters used in defining the sections mean nothing it is time to give up. They do, however, hold reasonably well if one will refrain from contradicting them and from describing in the glabrous § *Canadenses* plants with copious pubescence, or in the copiously glandiferous § *Alleghenienses* plants without glands, etc. The confusion is not primarily in the sections.

R. PENSILVANICUS Poir., forma **phyllophorus,** f. nov., racemis plus minusve elongatis, bracteis numerosis.—With the typical

few-bracted plant or in more favorable habitats. The following belong here. Nova Scotia: rich moist open thicket by brook, Sandy Cove, Digby County, *Fernald & Long*, no. 21,592, as *R. orarius;* spruce woods and thickets, Brazil Lake, Yarmouth Co., *Bartram & Long*, no. 23,991, as *R. orarius.* New Hampshire: borders of dry woods near Mascot Pond, Gorham, *Fernald & Pease*, no. 15,643, as *R. orarius;* dry thickets and borders of woods, Lincoln, July 28, 1917, *Fernald*, no. 15,701 (type in Herb. Gray); damp thickets, borders of woods and roadsides, Thornton Gore, *Fernald*, no. 15,642.

In its very leafy-bracted raceme resembling *R. allegheniensis*, forma *suffultus* (pl. 1131, fig. 1) except for its glandless and more corymbiform raceme and the subglobose fruits, characters which place it with the polymorphic *R. pensilvanicus* of § *Arguti.* See discussion above.

Rubus (§ Alleghenienses) **sceleratus** Brainerd, sp. nov. in lit., tab. 1131 et 1132, valde adscendens inextricabiliter arcuato-ramosus, cannis tholos 1.8–3 m. altos formantibus; primocannis ad 1 cm. diametro densissime armatis; aculeis rectis horizontalibus deltoideo-subulatis vel subulatis vel aciculiformibus, glandulis stipitatis intermixtis; primocannae foliis quinatis supra glabris subtus fulvo-tomentosis, foliolo terminali late ovato acuminato basi rotundo-cordato, duplicato-dentato; petiolo petiolulisque valde armatis glandulosisque; inflorescentiis racemoso- vel subpaniculato-corymbiformibus valde armatis; fructibus subglobosis 8 mm. diametro.—New Hampshire: clearings, alluvial terrace of Androscoggin River, Pontook Dam, Dummer, Coös County, September 6, 1917, *Fernald & Pease*, no. 15,649 (type in Herb. Gray.; isotypes in Herb. New Engl. Bot. Cl. and elsewhere).

Rubus sceleratus was so designated by Dr. Ezra Brainerd shortly before his death but, although duplicates of the large series were sent out under that name 30 years ago, I am surprised to find that the name he gave did not get published. The species is the most fiercely armed of any I have ever encountered in the field, comparable only with *R. pugnax* Bailey, Gent. Herb. v. fasc. viii. 524, fig. 235 (1944), which I know only in the herbarium. But, whereas true *R. pugnax* (type-series from Hartland, Connecticut) has the primocane quite glabrous and armed with pale and very broad-based prickles without intermixed glands, *R. sceleratus* has the primocanes densely crowded with stipitate glands, setae and fulvous prickles much more slender than in *R. pugnax.* The inflorescence of *R. pugnax* is similar to that of *R. allegheniensis*, an essentially simple and cylindric

raceme; that of *R. sceleratus* more corymbiform, with the pedicels often changed to forking branches; *i. e.*, it is related to the inclusive *R. glandicaulis* Blanchard. From that common species of southeastern Canada and northern New England it is at once distinguished by the very intricately branching and doming habit, the coarse and crowded prickles of the primocane, the strong armature of petiole and petiolule, the dense tomentum (instead of thin pilosity) of the lower leaf-surface, the spreading (instead of appressed or nearly wanting) pubescence of the nerves of the lower surface and the armed inflorescence.

At the big dam at Dummer *Rubus sceleratus* covered a very extensive area of recently burned clearing. While Pease and I were vainly struggling to secure some representative pieces without tearing to shreds the entrapped foliage (a nearly impossible task; note the illustrations), the keeper of the dam came to express his wonder at our performance and the hope that we would destroy several acres of the pest. Asked what kind of bramble he called it, his feelings were promptly indicated by his reply: "It's a damn nuisance!" Whereupon Pease and I, further struggling to get specimens without too seriously lacerating ourselves, composed a tentative name from Dummerdam and the conventional ending, *ensis*. Sending material to the Reverend Doctor Brainerd, who was then deep in his study of the genus, I received a letter, stating that the name we had used was a bad hybrid of profane English and Latin and that he was calling it *R. sceleratus*. He won but he did not find the opportunity to publish his milder profanity.

2. Rhizome-characters in and minor Forms of Viola

(Plates 1133–1136)

In studying the genus *Viola* as it occurs in eastern North America several cases have been noted where the plants with vernal petaliferous flowers would seem to indicate the need of uniting what have generally or often been considered distinct species. In view, however, of the prolonged and very painstaking study, reinforced by cultivation of and experimentation with our species and their hybrids by the late Ezra Brainerd, I, naturally, hesitated to make hasty and less considered changes. In seeking for characters not generally used but which, in care-

fully collected material, seem very real, I have turned to the vegetative reproduction and the rhizomes, features which in some other groups have been found to be quite stable. One of the cases in which the striking differences in the rhizome are already recognized is that of the eastern *V. canadensis* L., of rich mesophytic and deciduous forest of southeastern Canada and the eastern states, and the Cordilleran and mid-western *V. rugulosa* Greene, which in Wisconsin and Minnesota meets the generally more eastern plants (in Wisconsin, Dr. Fassett informs me, often characterizing shaded bluffs of Niagara limestone, rather than the more typical mesophytic forests). Very slight differences in outline of leaf and degree of scariousness of stipules have been noted but these are rather evasive and difficult to define. When, however, the subterranean parts are carefully dug it is found that the eastern *V. canadensis* is non-stoloniferous and with a stout rhizome (PLATE 1133, FIG. 1) and thick crown; whereas the western *V. rugulosa* spreads by slender, flexuous and freely forking subterranean stoloniform rhizomes (FIG. 2), these setting new crowns at their tips. So long as people are satisfied to snatch the plants without carefully digging the subterranean parts they will struggle to make out the differences. In fact Greene, describing *V. rugulosa* from Minnesota, without mention of stolons, followed it by the stoloniferous *V. Rydbergii*, the Rocky Mountain plant *with* slender stolons. Carefully made collections from the type-station in Minnesota of *V. rugulosa*, however, show the long and flexuous stolons of *V. Rydbergii*.

The very definite *Viola tripartita* Ell. is in its typical form at once distinguished from *V. hastata* Michx. by having the lower leaves of the foliaceous summit sharply divided into long narrow segments or lobes, but the later leaves are uncleft and suggest those of *V. hastata*. To increase the difficulty, there is an extreme form of *V. tripartita* with all the leaves uncleft, this form, forma *glaberrima*[1], so much simulating *V. hastata* that I find

[1] VIOLA TRIPARTITA Ell., forma **glaberrima** (Chapm.), stat. nov. *V. hastata* Michx., β.? DC. Prodr. i. 300 (1824)—without name, although by Harper said to have been called "var. *glaberrima* Ging.". *V. hastata*, var. *glaberrima* [wrongly ascribed to Ging.] Chapman, Fl. So. U. S. ed. 3: 34 (1897). *V. tripartita glaberrima* Harper in Bull. Torr. Bot. Cl. xxvii. 337 (1900). The citation of Gingins as the basic author seems to be erroneous. In DeCandolle's Prodromus, A. P. DeCandolle prepared the treatment except in cases where Gingins was actually cited.

nearly a quarter of the specimens of the two in the Gray Herbarium originally misidentified. Dr. Roland Harper has pointed out that in *V. hastata* the young leaves are flat, those of *V. tripartita* plicate, but that this difference does not show in pressed specimens. If, however, one has carefully collected material the rhizomes make the differentiation simple: the rhizome of *V. tripartita* and its forma *glaberrima* (PLATE 1133, FIG. 3) is subligneous, blackish and densely covered with long fibrous roots; that of *V. hastata* (FIG. 4) fleshy, whitish, coarsely toothed and subtuberous, strongly simulating the rhizome of *Dentaria* or of *Medeola*. Had the earlier authors noted the very different rhizomes they would hardly have united the two species.

The last cases to be noted here are in the usually recognized stoloniferous series. So long as the circumpolar *Viola palustris* L. has violet corollas and stays in alpine and subalpine ravines the flowering plants are quickly distinguished from those of the smaller-flowered *V. pallens* (Banks) Brainerd. There is no difficulty in distinguishing fruiting material, since the grayish seeds of *V. palustris* are 1.5–1.7 mm. long and a full mm. thick, the blackish seeds of *V. pallens* 1–1.4 mm. long and only 0.7–0.8 mm. thick. The trouble is with flowering material of *V. palustris*, forma *albiflora* Neum., which is found in subalpine ravines of Newfoundland. Both plants have deliciously fragrant vernal flowers and the difference in size is trifling. However, when properly collected *V. palustris* shows stiff and cord-like stolons 1–1.5 mm. thick, *V. pallens* having the stolons slenderly thread-like and flexuous. If the former is merely grabbed the crucial character will be missed.

Some acute field-botanists have asserted that, after all, *V. lanceolata* L. and *V. primulifolia* L. are merely leaf-variations of a single polymorphous species. Had they closely watched their growth-habit after the vernal flowering they would have seen a pretty striking difference. In *V. lanceolata*, very soon after the vernal flowering, the rhizome or crown sends out leafy prostrate stolons bearing cleistogamous flowers. By midsummer these highly fruitful leafy stolons form mats (PLATE 1134, FIG. 1) and by late autumn one finds extensive and close carpets with abundant dehiscing capsules. This character was clearly described more than a century ago, when Torrey & Gray (Fl. N. Am. i. 139

(1838)) wrote: "Rhizoma creeping; often bearing very long creeping stolons with an apetalous flower on a short peduncle at each joint". Of the hundreds of collections of *V. lanceolata* before me essentially all which show plants past vernal flowering exhibit the floriferous and leafy stolons.

In *Viola primulifolia*, however, it is a very exceptional plant which shows many or any cleistogamous flowers on the stolons; and up to midsummer the very long and freely forking stolons remain leafless or essentially so, the cleistogamous flowers being on erect and prolonged peduncles borne chiefly from the crowns or from the first nodes of the stolons (PLATE 1135, FIG. 1).[1] Much later in the season, in September and October, the stolons may bear well developed leaves but no (or very exceptional) short-stalked cleistogenes. This final production of leaves on the stolons, which eventually end in new crowns, and the absence of cleistogenes except from the crowns, is well displayed in an isotype (*Harper*, no. 1675, from near Moultrie, Georgia, coll. September 25, 1902) of *V. reptabunda* Greene, Leaflets, ii. 94 (1910), our PLATE 1135, FIGS. 2 and 3. Such autumnal development of leaves on the stolons is shown in many specimens of typical cordate- or subcordate-leaved *V. primulifolia*[2] and its north-ranging var. *acuta*.

The last of these plants to consider is *Viola vittata* Greene, Pittonia, iii. 258 (1898) or *V. lanceolata* L., var. *vittata* (Greene) Weath. & Grisc. in RHODORA, XXXVI. 48 (1934), a plant of the

[1] The specimen from which this figure was made (*Fernald & Long*, no. 21,925 from Arcadia, Nova Scotia, July 29, 1920) is of *V. primulifolia*, var. *acuta* (Bigelow) Torr. & Gray, l. c. (1838), this based on *V. acuta* Bigelow, Fl. Bost. ed. 2: 95 (1824), which came from "Cambridge [Mass.], particularly about the pine trees on Craigie's road [now Brattle Street], in moderately damp soil". Edward Tuckerman deposited in the Gray Herbarium material which he marked as identical with Bigelow's plant, adding that Bigelow had sent him specimens from the original station. The latter locality, "the pine trees on Craigie's road", was apparently the wet depression beneath large white pines between Brattle and Craigie Streets, which was still conspicuous when the present writer came to Cambridge in 1891.

[2] When *V. primulifolia*, forma *subcordata* Griscom in RHODORA, XXXVIII. 50 (1936) was defined: "Foliis maioribus subcordatis vel rariore cordatis, saepe crassioris vel rugosis", growing from Florida "North along the coast to southeastern Maryland", the Linnaean account of typical *V. primulifolia* was apparently not given sufficient weight: "foliis oblongis subcordatis" followed by "*Folia cordata, oblonga, obtusissima, crenata, basi decurrentia per petiolum, omnino ut in Primula officinali.*". Typical *V. primulifolia*, with cordate to subcordate leaves, extends northward on the Coastal Plain to New Jersey and inland from the Gulf to Oklahoma. Var. *acuta*, with blades not cordate, reaches Nova Scotia, New Brunswick, central Maine, southern Quebec, southern Ontario, Michigan and Minnesota.

southern Coastal Plain, extending north to southern New Jersey and inland to Coffee County, Tennessee. At vernal flowering the leaves and flowers are often indistinguishable from those of typical *V. lanceolata* but as the season advances the new leaves are greatly prolonged and narrow, with lance-linear blades 0.6–3 dm. long, their margins often (but not always) more denticulate, the peduncles relatively high. However, the evident transition in foliage induced Weatherby & Griscom to treat it as a variety of *V. lanceolata*, a course which Alphonso Wood had indicated on the label of a Georgia specimen from Professor William T. Feay more than 80 years ago (Wood's manuscript name not published). In southeastern Virginia the few known colonies of *V. vittata* (or var. *vittata*) show none of the leafy superficial stolons with axillary cleistogenes which characterize typical *V. lanceolata* (PLATE 1134, FIG. 1). Instead, the plant spreads by slender cord-like subterranean rhizomes which at their tips set new leafy crowns (PLATE 1134, FIG. 2). Since, however, the plant is more abundant southward I have asked for and received the loan of the material in the Britton Herbarium of the New York Botanical Garden for which I am very thankful. This series and that of the Gray Herbarium, although often duplicating one another, are mutually very helpful, for the latter series contains material from three southern states not represented in the former. Furthermore, while the rhizome-character receives much confirmation, the presence of superficial flowering stolons is apparent in several plants which, in their very prolonged leaves, are otherwise good *V. vittata*. Of the 77 specimens studied a few are so carelessly collected as to give no evidence, but 43 clearly show the subterranean rhizome and no superficial stolons, while 12 collections as clearly show the superficial leafy stolons, some of them bearing axillary cleistogenes as in typical *V. lanceolata*. Among these superficially stoloniferous plants may be cited *Small*, no. 8710 from Indian River, Coco, Florida; *Tracy*, no. 5006 from Biloxi, Mississippi; and *Brainerd*, no. 179, raised from Biloxi roots. Such plants as these seem to indicate that, in spite of the great length of the leaves and the generally non-stoloniferous habit, *V. vittata* is perhaps better considered a well defined southern variety of the more widely dispersed and usually shorter-leaved *V. lanceolata*. Such transitional material sug-

gests the need of also watching closely the behavior of *V. canadensis* (PLATE 1133, FIG. 1) and *V. rugulosa* (FIG. 2).

The following minor forms may be noted:

V. PEDATA L., var. LINEARILOBA DC., forma **ranunculifolia** (Juss.), stat. nov. *V. ranunculifolia* Juss. ex Poir. Encycl. viii. 626 (1808). *V. pedata*, γ. *ranunculifolia* (Juss.) Gingins ex DC. Prodr. i. 291 (1824) as to source of name, not as to plant described.

Forma *ranunculifolia* (see PLATE 1136, FIGS. 1 and 2) occurs rather rarely through much of the range of typical var. *linearilobа;* specimens before me from Massachusetts, Rhode Island, North Carolina, South Carolina and Georgia. A leaf and a flower from Jussieu's TYPE are shown in PLATE 1136, FIGS. 1 and 2. Although the name, used in varietal rank by Gingins in DeCandolle's Prodromus, was taken over directly from Jussieu, the plant he had before him in the Prodromus herbarium of DeCandolle belonged to the next form.

V. PEDATA L., var. LINEARILOBA DC., forma **cuneatiloba** Brainerd in herb., f. nov. (TAB. 1136, FIG. 3), segmentis foliorum cuneato-obovatis leviter incisis.—TYPE from 3000 ft. alt., Kate's Mountain, near White Sulphur Springs, Greenbrier Co., West Virginia, May 16, 1892, *J. K. Small* in Herb. Gray.

The type and another sheet in the Gray Herbarium bear Brainerd's annotation-labels. These and several others bear a later unpublished combination. Some sheets have Brainerd's intimation that these plants with broadly cuneate and but slightly cleft leaf-segments are specimens with autumnal foliage. This annotation appears beside a plant from Woburn, Massachusetts, with flowers expanded; all other specimens of this form are indicated as collected in May or show expanded flowers. Not only do these sheets bear unpublished annotations. Most of the sheets of forma *cuneatiloba* bear an unpublished combination by Brainerd with a basonym which was published later than Jussieu's name. Similar annotations are presumably in other herbaria.

V. FIMBRIATULA Sm. forma **umbelliflora,** f. nov. (TAB. 1136, FIG. 4), pedunculis trifloris, floribus subumbellatis; foliis basin versus valde incisis. TYPE from Halifax, Nova Scotia, July 20, 1912, *J. Richard Lunt* in Herb. Gray.

Forma *umbelliflora* is an extraordinary departure from the common and typical *Viola fimbriatula*, for the latter, like all the

species of the *Cucullata* group of *Viola*, has single-flowered peduncles. Unfortunately Mr. Lunt did not record more explicitly than Halifax, the locality; but here is a plant which should be sought by Nova Scotians.[1]

V. ADUNCA Sm., var. **minor** (Hook.), comb. nov. *V. Muhlenbergiana*, β. *minor* Hook. Fl. Bor.-Am. i. 78 (1830). *V. labradorica* Schrank in Denkschr. Bot. Ges. Regensb. i². 12 (1818). *V. adunca*, var. *glabra* Brainerd in RHODORA, XV. 109 (1913). *V. adunca*, forma *glabra* (Brainerd) G. N. Jones in Univ. Wash. Publ. Biol. v. 194 (1936).

In taking up var. *minor* for the glabrous and commonly more boreal or subalpine extreme of *Viola adunca* the earliest varietal name is revived. Hooker's variety was based on citations of plants of various authors under the name *V. debilis* Pursh, not Michx., including the Richardson material. A specimen of the latter labelled *V. debilis* by Richardson himself is the same as var. *glabra* of Brainerd. I have sought in vain for any character to hold the latter apart from *V. labradorica*. The var. *minor* (or *glabra*) in eastern North America extends 900 miles farther north than typical puberulent *V. adunca;* and at its southern limit in the East it ascends into alpine areas, typical *V. adunca* in the East never doing so.

EXPLANATION OF PLATES 1133–1136

PLATE 1133, RHIZOMES OF VIOLA: FIG. 1, V. CANADENSIS L., × 1, from Hudson Falls, Washington Co., New York, May 24, 1918, *House;* FIG. 2, V. RUGULOSA Greene (*V. Rydbergii* Greene), × 1, originally from Boulder, Colorado, transplanted to Middlebury, Vermont, and distrib. in Brainerd's Violets of E. N. Am., no. 138; FIG. 3, V. TRIPARTITA Ell., forma GLABERRIMA (Chapm.) Fern., × 1, from north of Fort Payne, DeKalb Co., Alabama, *Svenson*, no. 7701, as *V. hastata;* FIG. 4, two rhizomes, × 1, of V. HASTATA Michx. from Tallulah Falls, Georgia, *Perry & Strahan*, no. 948.

PLATE 1134, RHIZOMES OF VIOLA: FIG. 1, V. LANCEOLATA L., × 1, from Bridgewater, Nova Scotia, *Fernald & Long*, no. 24,180; FIG. 2, V. LANCEOLATA, var. VITTATA (Greene) Weath. & Grisc. (*V. vittata* Greene), × 1, from Whitefield's Millpond, southwest of Corinth, Southampton Co., Virginia, *Fernald & Long*, no. 14,368.

PLATE 1135, RHIZOMES OF VIOLA: FIG. 1, V. PRIMULIFOLIA L., var. ACUTA (Bigel.) Torr. & Gray, × 1, from Arcadia, Nova Scotia, *Fernald & Long*, no. 21,925; FIGS. 2 and 3, typical V. PRIMULIFOLIA, from ISOTYPE of *V. reptabunda* Greene, × 1, from near Moultrie, Colquitt Co., Georgia, *Harper*, no. 1675.

PLATE 1136: FIGS. 1 and 2, leaf and flower of TYPE, × ½, of VIOLA PEDATA L., var. LINEARILOBA DC., forma RANUNCULIFOLIA (Juss.) Fern. (*V. ranunculifolia* Juss.); FIG. 3, portion of TYPE, × 1, of V. PEDATA, var. LINEARILOBA, forma CUNEATILOBA Brainerd; FIG. 4, portion of TYPE, × 1, of V. FIMBRIATULA Sm., forma UMBELLIFLORA Fern.

[1] On the same trip Mr. Lunt, on July 18, collected *Calamagrostis cinnoides* (Muhl.) Bart., the locality given simply as Halifax, this the first evidence of the species from east of York County, Maine.

To be continued

CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD UNIVERSITY—No. CLXIX.

Part II. STUDIES OF EASTERN AMERICAN PLANTS

M. L. Fernald

(*Continued from page 57*)

3. Some Varieties in Oenothera (Plates 1137–1143)

In studying the true Oenotheras of the "Manual range" I have, unfortunately, been unable to compile from a treatment of the group, such as Dr. Philip A. Munz has so satisfactorily supplied for the other subgenera. The long hoped-for study by him of § *Onagra* is still anxiously awaited. In the meantime the necessity to do something with this most variable and perplexing series (made more perplexing through the evident hybridization of species and the superabundance of vegetative mutants which have been described as "species") has necessitated two weeks of sorting and resorting of many hundreds of collections. It is gratifying to note that the primary distinctions several times emphasized by Wiegand seem to be of fundamental importance. Aside from the cultivated and escaped *O. grandiflora* Ait. (including the very similar *O. grandiflora* Lam. or *O. Lamarckiana* Ser.) and the Alleghenian *O. argillicola* Mackenzie (seeds shown in PLATE 1138, FIG. 11), we have what seem like three primary species, with fairly definite characters in habit, calyx and seeds. These technical but seemingly well established characters are shown in the plates prepared with her usual care by Dr. Schubert.

I am taking up *O. biennis* in the long-accepted sense, although much argument has been published, to the effect that something which had long been cultivated in Europe, and which had

spread to the open in northwestern continental Europe, cannot be matched with anything American. Before me, however, is a photograph of a plant which Linnaeus described in Hortus Cliffortianus, marked by him "*biennis*", which shows the distant, thin and spreading-ascending leaves, the tips of the calyx-lobes united at base into a definite tube and other characters which strikingly suggest *O. biennis* as interpreted by Robinson & Fernald and by Wiegand. A specimen in the Linnaean Herbarium (no. 484.1), which Linnaeus had before him in preparing ed. 1 of Species Plantarum, is also characteristic of the species as understood (very like the Hort. Cliff. specimen). Furthermore, specimens from various parts of Europe are the same; thus, material growing on dunes of the Ostfriesisch Inseln and sent by the late Professor Buchenau as *O. muricata* L. is partly of that plant, partly (our PLATE 1137, FIG. 1) of *O. biennis*.

O. biennis, then, has the membranaceous leaves minutely soft-pilose beneath, lanceolate to lance-oblong or sometimes oblong-ovate; the bracts of the inflorescence (except in one local var.) shorter and finally deciduous, leaving a naked fruiting spike; the calyx-lobes in the unexpanded buds with the slender tips closely connivent or parallel at base, thus forming a tube (PLATE 1137, FIGS. 1–4 and PLATE 1138, FIGS. 1–3, 7 and 9); the expanded and reflexed calyx-lobes (PLATE 1137, FIGS. 4, 5, 8 and 9, and PLATE 1138, FIGS. 5 and 8) 1–2.5 cm. long and arching or extending straight back (not deflected by the auricle). The fully mature seeds are 1.2–1.8 (–2) mm. long and 0.6–1.2 mm. broad, their angles (under magnification) with very narrow wings (PLATE 1137, FIGS. 6 and 10, and PLATE 1138, FIGS. 6 and 10). This collective species has four well defined geographic varieties. Typical *O. biennis* (PLATE 1137, FIGS. 1–6) or var. *vulgaris* Torr. & Gray, has the surfaces of the calyx, ovaries and capsules evident, and more or less villous, or the capsules merely hirsute and 1.5–3.5 cm. long. It is wide-ranging in dry soil from Newfoundland and the Côte Nord of Quebec to southeastern Alberta (local west of Manitoba), south to Nova Scotia, New England, Long Island, northern Florida, Tennessee, Arkansas, North Dakota and Idaho. Among minor trends are *O. comosa*, *grandifolia*, *Hazelae*, *novae-scotiae*, *parva* and *Royfraseri* R. R. Gates and *O. Victorini* Gates & Catcheside.

Very similar but with the often viscid body of the calyx (PLATE 1137, FIGS. 7–10) glabrous or essentially so, the glabrescent capsules only 1–2.5 cm. long, is var. *nutans* (Atkinson & Bartlett[1]) Wiegand in RHODORA, XXVI. 3 (1924), based on *O. nutans* Atkinson & Bartlett in Science, n. s. xxxvii. 717 (1913) and RHODORA, XV. 83 (1913), ranging from New York to Georgia.

The other two most significant varieties have firmer and strongly ascending leaves. Their calyx-lobes, ovaries and capsules have the surfaces hidden by dense canescent or whitish pubescence. Var. *canescens* Torr. & Gray, Fl. N. Am. i. 492 (1840) (our PLATE 1138, FIGS. 1–6) has the pubescence of calyx and capsule of closely appressed and short strigae. It ranges from southern Quebec to southeastern Alberta, south to the coast of eastern New Brunswick, western New York, southern Ontario, Ohio, Illinois, Missouri and Oklahoma, being primarily a variety of the prairies. It includes *O. canovirens* Steele and *O. eriensis*, *niagarensis* and *repandodentata* R. R. Gates and passes insensibly into var. *hirsutissima* Gray in Mem. Am. Acad., n. s. iv[1]. (Pl. Fendl.) 43 (1849) and in Pl. Wright. i. 69 (1852), our PLATE 1138, FIGS. 7–10. Var. *hirsutissima* has the pubescence of capsule and calyx with many ascending to spreading long villi. Gray defined var. *hirsutissima* in peculiarly bifurcate fashion: in Plantae Fendlerianae (1849), enumerating Fendler's New Mexican plants, he had

"218. OENOTHERA BIENNIS, VAR. HIRSUTISSIMA. Valley of Santa Fé Creek, in the mountains; June. Plant 2 to 3 feet high", he completing the description in Plantae Wrightianae three years later: "190. OE. BIENNIS, *Linn.*, var. Along the Limpia.—This is the same strigose-hirsute variety as No. 218, *Pl. Fendl.*, a form which is common in Oregon and along the Rocky Mountains".

This, of course, is the transcontinental plant which was defined as *Onagra strigosa* Rydberg, Mem. N. Y. Bot. Gard. i. 278 (1900) and which was reduced to varietal rank as *Onagra biennis*, var. *strigosa* (Rydb.) Piper in Piper & Beattie, Fl. Palouse Reg. 124 (1901) and transferred to *Oenothera* as *Oenothera strigosa* (Rydb.) Mackenz. & Bush, Man. Fl. Jackson Co., Mo. 139 (1902). The dominant extreme of the species in the cordil-

[1] The citation in Index Londinensis of H. H. Bartlett as "Bartl." is misleading, in view of the long use of that abbreviation for Bartling.

leran region, var. *hirsutissima* is found in the East, especially near the coast. Its broad range is from southern Quebec to western British Columbia, south to Prince Edward Island, southern New England, New Jersey, Pennsylvania, Michigan, Illinois, Kansas, Texas, New Mexico, Arizona and northern Mexico.

Just as *Oenothera biennis* has more or less defined geographic varieties with pronounced differences in the density of pubescence of calyx, capsule, etc. but with the same form of calyx-lobes and with small seed with evident thin and narrowly winged angles, so do the other two most common species of the East present somewhat definite varieties along parallel lines. In these two species the calyx has the slender tips not connivent and forming a tube at base; but in the bud they are distinct to base and somewhat distant (PLATE 1139, FIGS. 1 and 2 and 4, 5, 6 and 8, PLATE 1140, FIGS. 1 and 2, PLATE 1141, FIGS. 1–4, and PLATES 1142 and 1143. The auricle at junction of blade and slender tip is rather prominent and in the expanded calyx the tip is somewhat deflected, instead of continuing the direction of the blade, being usually 1–3 (rarely –5) mm. long. In these species the fully developed seeds are plump and larger than in *O. biennis* and filled out to the angles, which lack or nearly lack the evident thin and narrow wing (seen under magnification) of the latter species.

The first of these two is *Oenothera parviflora* L., Syst. ed. 10: 998 (1759) and Sp. Pl. ed. 2: 492 (1762) or *O. muricata* L. Syst. ed. 12: 263 (1767). The first description of Linnaeus was brief and misleading, for the emphasis was placed on a supposed 8-cleft summit of the fruit: "*Margo coronans fructum, non uti praecedentis quadrifidus, sed octofidus est*"; but the full description of 1762 was most satisfactory in saying: "Caulis *pilis adspersus, sed absque tuberculis ad eorum basin* . . . Calyx *tubo* . . . *infra apicem denticulo notatus, hinc ante explicationem mucrones in hac distantes*". The specimen in the Linnaean Herbarium (sheet 484.2) clearly marked by him as "*parviflora*" (photograph, like those of *O. biennis* and *O. muricata*, unfortunately too weak for reproduction) is a flowering one, with the long bracts and perfectly characteristic calyx of the plant identified by Wiegand as *O. parviflora*. Similarly, Linnaeus's type of *O. muricata*

(sheet 484.3) is from an older plant, with well developed capsules subtended by long ascending bracts, the calyx-tips as in the earlier published *O. parviflora*. This is most fortunate, for no change of interpretation is necessitated.

Oenothera parviflora, then, is characterized by its free calyx-tips, with evident auricle which deflects the tip; by its obovate petals; its simple or rarely branching stem 1–8 dm. high; the foliage-leaves passing without obvious change into the bracts, which are prolonged and which persist on the leafy-bracted fruiting spike; and by the large (2–2.6 mm. long, 1–1.8 mm. broad) and plump seeds without any or with scarcely any thin wings.

The typical variety has the upper (often the lower) half of the stem beset with long spreading hairs, often on enlarged reddish pustular bases; the fresh leaves rather fleshy and firm, ascending, strigose to glabrescent beneath; calyx and capsule more or less strigose-villous. It abounds on gravelly shores, talus (often calcareous), sands and dry open soil from Newfoundland and the Côte Nord of Quebec to James Bay and the Thunder Bay District of Ontario, south to Nova Scotia, New England and New York. Var. *angustissima* (R. R. Gates) Wiegand in RHODORA, xxvi. 3 (1924), based on *Oenothera angustissima* R. R. Gates in RHODORA, xv. 46, pl. 100 and 101 (1913), differs in the stem, leaves, calyx and capsule being glabrous or essentially so (our PLATE 1139, FIGS. 4–6), thus paralleling *O. biennis*, var. *nutans* and, like it, chiefly Alleghenian, known from southwestern Quebec to western New York, south to the District of Columbia and West Virginia.

The third variety of *O. parviflora* is the chiefly coastal extreme with close and canescent, minute pubescence on stem, lower leaf-surfaces, backs of calyx-lobes and capsules, *O. Oakesiana* Robbins. This plant, with all the general characters of *O. parviflora* but with the auricle at summit of the calyx-lobes often longer and more conical than in typical *O. parviflora*, had a rather shaky nomenclatural start. Robbins sent a sheet of it (PLATE 1140, FIG. 1) to Asa Gray, with this label:

> "*Oenothera Oakesiana*, sp. ined. Robbins
> Annua, Oe. bienni minor; pubescentiâ molliore, adpressa; apicibus calycis divergentibus; caps. longiori, acutiori; seminibus majoribus.

Foliis insuper angustioribus, agrestum ad Norton, Mass. in arenosis, cultam ex seminibus ad Apponaug, R. I., lectis Aug., 1865 et legit ad New Haven, Conn., primum 1827."

Gray immediately took it up in his Man. ed. 5: 178 (1867) but as *O. biennis*, "Var. 5. Oakesiàna (OE. Oakesiana, *Robbins*)", Robbins's binomial thus published technically as a synonym. Sereno Watson did not do much better in his *Revision of the extra-tropical North American Species of the Genus Oenothera*, for there, in Proc. Am. Acad. viii. 579 (1873), under an all-inclusive *O. biennis*, he said: "The more strigose form is *OE. muricata*, Murr.; the more softly pubescent is *OE. Oakesiana*", without any author cited. In his Bibliographical Index, 383 (1878), however, the plant came into full recognition as "**OE. Oakesiana.** Robbins, in herb." with the two previously noted publications obscurely cited in the synonymy. But in these and later shifts of the name Robbins's noting of the two most significant characters, "apicibus calycis divergentibus" and "seminibus majoribus", was quite ignored. Robbins understood his plant; those who published it did not! In all its characters, except the cinereous and very fine pubescence, it is inseparable from *O. parviflora*. I am, therefore, calling it

O. parviflora L., var. **Oakesiana** (Robbins), comb. nov. *O. biennis*, var. *Oakesiana* (*O. Oakesiana* Robbins) Gray, Man. ed. 5: 178 (1867). *O. Oakesiana* as a binomial "form" of *O. biennis*, S. Wats. in Proc. Am. Acad. viii. 579 (1873). *O. Oakesiana* Robbins in herb. in S. Wats. Bibl. Index, 383 (1878). *O. Oakesiana* Robbins ex Wats. & Coult. in Gray, Man. ed. 6: 190 (1890). *Onagra Oakesiana* Britton in Mem. Torr. Bot. Cl. v. 233 (1894). *Oe. Tidestromii* Bartlett in Cybele Columb. i. 54, pl. 5 (1914).—Sands along the coast and rarely inland, Plymouth and Worcester Counties, Massachusetts, to Northampton County, Virginia. Plate 1140.

The second species with the tips of the calyx-lobes deflected above the auricle and the seeds plump and relatively large is *O. cruciata* Nutt. in G. Don, Syst. ii. 686 (1832) or *O. biennis*, ε. *cruciata* (Nutt.) Torr. & Gray, Fl. N. Am. i. 492 (1840) (our plate 1139, fig. 8, and plate 1141). Typical *O. cruciata* is habitally much like *O. biennis* and mostly with ascending branches, the cauline leaves membranaceous, acute and distant, leaving long reddish internodes exposed, minutely pilose beneath;

and the bracts quickly fall after the flowering, thus leaving long naked spikes of capsules. In these characters it would go with *O. biennis;* but its calyx-lobes are much as in *O. parviflora,* with tips free in the bud and in the expanded lobes deflected, the petals linear and only 1–3 mm. broad, the longest styles only up to 1.2 cm. long, and the seeds (PLATE 1141, FIG. 7) plump and as large as or larger than in *O. parviflora.* The typical plant, with villous-strigose stem, remote leaves and loosely spreading-villous calyx, is a very characteristic species, especially on gravelly beaches or bars of streams and ponds of a limited area: from southeastern and central Maine to northeastern New York, southward to Middlesex County, Massachusetts, Providence County, Rhode Island, and Hartford County, Connecticut. Quite isolated from the typical plant are two insular departures from it. The first is

O. CRUCIATA Nutt., var. **sabulonensis,** var. nov., TAB. 1142, caulibus 3–3.5 dm. altis simplicibus adpresse canescento-pilosis; foliis oblongis subobtusis plerumque 1.5–2.5 cm. latis subapproximatis subintegris; calycibus sparse minuteque pilosis; capsulis 8–10 mm. crassis laxe villosis.—NOVA SCOTIA: Sable Island, July 24, 1899, *John Macoun,* no. 21,193; edge of gully in sand-dunes, Sable Island, August 18, 1913, *St. John,* no. 1283 (TYPE in Herb. Gray.).

Var. *sabulonensis,* isolated by 300 miles from the eastern limit of typical *Oenothera cruciata* and with a stretch of 100 miles of sea separating it from the mainland, differs at once from the latter plant in its simple and low stems only 3–3.5 dm. high (in typical *O. cruciata* mostly branching and up to 1 m. high), approximate, instead of distant leaves, these bluntish, oblong and subentire (in typical *O. cruciata* lanceolate, acute and repand-denticulate); calyx minutely and sparsely pilose, instead of villous; capsule 8–10, instead of 5–7 mm. thick. Further material, especially with plenty of flowers and mature seeds, may show other departures.

On the islands of Nantucket and Martha's Vineyard, like Sable Island isolated remnants of the Cretaceous and Tertiary Coastal Plain, *Oenothera cruciata* is represented by

O. CRUCIATA Nutt., var. **stenopetala** (Bicknell), stat. nov., our PLATE 1143. *O. stenopetala* Bicknell in Bull. Torr. Bot. Cl. xli. 79 (1914).

Var. *stenopetala*, described in great detail by Bicknell, was considered by him to have "its real affinity . . . not with *O. cruciata*, a near-relative of *O. biennis*, but rather with *O. Oakesiana* with which it agrees closely in pubescence and to some extent in the form of the capsule". Perhaps so, but Bicknell's characterization of *O. cruciata* shows considerable unfamiliarity with that plant. His "bracts subtending the flowers [in *O. cruciata*] are broad based, not narrowly tapering or petiolulate" is unfortunate in view of the bracts of *O. cruciata* (summit of Nuttall's type in PLATE 1139, FIG. 8). The very narrow petals and the tendency to elongate branching (ISOTYPE in PLATE 1143, FIG. 1) seem to me to ally *O. stenopetala* with *O. cruciata*, but the question is far from settled. The plant is distinguished by its slender stem cinereous with crowded minute appressed pubescence; narrowly lanceolate or oblanceolate acute and repand-denticulate firm leaves only 0.4–1.5 cm. broad, these closely cinereous-strigose beneath; calyx and capsule similarly cinereous. As already noted, its status is still not wholly clear. It is an *Oenothera!*

O. TETRAGONA Roth, var. **hybrida** (Michx.), comb. nov. *O. hybrida* Michx. Fl. Bor.-Am. i. 225 (1803). *Kneiffia tetragona*, var. *hybrida* (Michx.) Pennell in Bull. Torr. Bot. Cl. xlvi. 371 (1919). *O. tetragona*, var. *Fraseri* (Pursh) Munz, forma *hybrida* (Michx.) Munz in Bull. Torr. Bot. Cl. lxiv. 300 (1937).

O. TETRAGONA, var. **latifolia** (Rydb.), stat. nov. *Kneiffia latifolia* Rydb. in Torreya, xxvii. 86, pl. 3 (1927). *O. tetragona*, var. *Fraseri*, forma *latifolia* (Rydberg) Munz, l. c. 301 (1937).

Although Munz treats these two plants as mere forms of *Oenothera tetragona*, var. *Fraseri* (based on *O. Fraseri* Pursh, Fl. Am. Sept. ii. 734 (1814)), the first "Like var. *Fraseri* but with spreading hair on stems, leaf-veins, etc.", the second "Like var. *Fraseri*, but finely strigose", the differences seem to me more than direction and abundance of trichomes. *O. Fraseri* is glabrous throughout, apparently inseparable from *O. glauca* Michaux, Fl. Bor.-Am. i. 224 (1803), a photograph of the type before me; *O. Fraseri* (at least plants raised from Fraser's seeds) illustrated in Bot. Mag. xl. t. 1674 (1814), with citation of Pursh's description. *O. glauca* was well illustrated in Bot. Mag. xxxix. t. 1606 (1814). Not only is var. *Fraseri* glabrous; its oval to broadly ovate leaves are mostly 2–4 cm. broad, with only

1–3 (rarely –4) low dentations per 2 cm. of margin, the leaves usually not subtending axillary fascicles; its petals 2–3 cm. long. It seems to be restricted to uplands of Virginia, West Virginia, possibly Ohio (Michaux's label of *O. glauca* reading: "Ouest de Ohio Route aux Illinois") and south along the mountains into western North Carolina and eastern Tennessee.

Vars. *hybrida* and *latifolia*, on the other hand, are both usually pubescent and both have lanceolate to narrowly lance-ovate leaves, the largest ones only 1–2 cm. broad (in the types of both 1 cm. broad), and their margins have 4–6 teeth per 2 cm.; in practically all specimens suppressed axillary branches or fascicles are abundant, and the petals may be as short as 1 cm. (not with a minimum of 2.5 cm.). Var. *hybrida*, characterized by spreading pubescence on stem, leaves, calyx and capsule, extends from the upland of Tennessee and North Carolina out to the inner margin of the Coastal Plain of Virginia. Var. *latifolia* extends from the mountains of eastern Tennessee and western North Carolina north into eastern West Virginia, northern Virginia (Clarke Co.) and southern Pennsylvania (Fayette and York Cos.). With narrower leaves, abundant axillary fascicles, development of pubescence, usually smaller petals and wider ranges eastward or northward, they are not satisfactorily treated as merely pubescent forms of var. *Fraseri*.

Explanation of Plates 1137–1142

Plate 1137. Oenothera biennis L.: fig. 1, portion of plant, × 1, from dunes of the Ostfriesische Inseln, August 12, 1900, *Buchenau;* fig. 2, calyx, × 1, from Ile de Brion, Magdalen Islands, Quebec, *St. John*, no. 1937; fig. 3, calyx, × 3, from Sheffield, Massachusetts, June 15, 1919, *J. R. Churchill;* fig. 4, expanded flower, × 1, from same collection as fig. 3; fig. 5, expanded flower, × 1, from Cass Lake, Minnesota, *A. M. Johnson*, no. 3191; fig. 6, seeds, × 5, from Shelburne, New Hampshire, *A. H. Moore*, no. 4875.

O. biennis, var. nutans (Atkinson & Bartlett) Wieg.: fig. 7, calyx, × 3, from south of Petersburg, Virginia, *Fernald & Long*, no. 9604; fig. 8, expanded flower, × 1, from no. 9604; fig. 9, expanded flower from east of Corinth, Warren Co., New York, *House*, no. 28,028; fig. 10, seeds, × 5, from Garrett Co., Maryland, *Steele*, no. 94.

Plate 1138. Oenothera biennis L., var. canescens Torr. & Gray: fig. 1, calyx, × 1, from Cherryfield, Saskatchewan, *Herriot*, no. 72,378; fig. 2, calyx, × 1, of isotype of *O. canovirens* Steele, from Concord, Morgan Co., Illinois, August 20, 1910, *Steele;* fig. 3, calyx, × 3, from same plant as fig. 2; fig. 4, ovary and portion of calyx, × 3, from Clay Co., Iowa, *Ada Hayden*, no. 10,084; fig. 5, expanded flower, × 1, from *Herriot*, no. 72,378; fig. 6, seeds, × 5, from Story Co., Iowa, August 15, 1933, *Ada Hayden*.

O. biennis, var. hirsutissima Gray: fig. 7, calyx, × 1, from Grand Teton National Park, Wyoming, *L. O. Williams*, no. 965; fig. 8, expanded flower, × 1, from New Plymouth, Idaho, *J. F. Macbride*, no. 733; fig. 9, calyx, × 3,

from *Williams*, no. 965; fig. 10, seeds, × 5, from Harrison Lake, Vancouver Island, *Carter*, no. 249.

O. argillicola Mackenzie: fig. 11, seeds, × 5, from Sweet Springs, West Virginia, *Steele & Steele*, no. 328.

Plate 1139. Oenothera parviflora L.: fig. 1, calyx, × 1, from Rivière à Pierre, Gaspé Co., Quebec, *Pease*, no. 20,303; fig. 2, expanded flower, × 1, from no. 20,303; fig. 3, seeds, × 5, from Cape Aylesbury, Prince Edward Island, *Fernald, Long & St. John*, no. 7835.

O. parviflora, var. angustissima (R. R. Gates) Wieg.: fig. 4, summit of plant, × 1, from general type-area, Lansing, New York, *Eames & Wiegand*, no. 10,461; fig. 5, calyx, × 1, from same plant as fig. 4; fig. 6, calyx, × 3, from same plant as figs. 4 and 5.

O. parviflora, var. Oakesiana (Robbins) Fernald: fig. 7, seeds, × 5, from Provincetown, Massachusetts, *Fernald & Long*, no. 18,845.

O. cruciata Nutt.: fig. 8, portion of type in Herb. Brit. Mus., × ca. ½.

Plate 1140. Oenothera parviflora L., var. Oakesiana (Robbins) Fernald: fig. 1, summit of type, × 1; fig. 2, bud, × 1, from topotype of *O. Tidestromii* Bartlett, from Millstone Landing, St. Marys Co., Maryland, *Blake & Tidestrom*, no. 11,666; fig. 3, ovary and portion of calyx, × 3, from last specimen.

Plate 1141. Oenothera cruciata Nutt.: fig. 1, summit of plant, × 1, from Nelson, New Hampshire, July 9, 1932, *F. W. Batchelder;* fig. 2, calyx, × 1, from Lexington, Maine, *Fernald & Strong*, no. 445; fig. 3, calyx, × 3, from no. 445; fig. 4, expanded flower, × 1, from no. 445; fig. 5, capsule, × 1, from Granville, New York, *F. T. Pember*, no. 20; fig. 6, same capsule, × 3; fig. 7, seeds, × 5, from Rollinsford, New Hampshire, September 2, 1896, *Parlin*.

Plate 1142. Oenothera cruciata Nutt., var. sabulonensis Fernald, all figs. from type: fig. 1, upper half of plant, × 1; fig. 2, bud, × 1; fig. 3, bud, × 3.

Plate 1143. Oenothera cruciata Nutt., var. stenopetala (Bicknell) Fernald: fig. 1, isotype, × 1, of *O. stenopetala* Bicknell, from Nantucket Island, Massachusetts, August 5, 1906, *Bicknell;* fig. 2, calyx, × 1, fig. 3, calyx, × 3, and fig. 4, expanded flower, × 1, all from Nantucket, August 18, 1917, *J. R. Churchill*.

4. Emendations in the Order Tubiflorae

(Plates 1144 and 1145)[1]

Convolvulus spithamaeus L., var. **pubescens** (Gray), comb. nov. *Calystegia sepium* (L.) R. Br., var. *pubescens* Gray, Man. ed. 5: 376 (1867). *Convolvulus sepium* L., var. *pubescens* (Gray) Fernald in Rhodora, x. 55 (1908), as to basonym only. *Calystegia Catesbeiana* Pursh, Fl. Am. Sept. ii. 729 (1814). *Convolvulus Catesbeianus* (Pursh) Ell., Sk. i. 255 (1817). *C. spithamaeus*, var. *Catesbeianus* (Pursh) Tryon in Rhodora, xli. 417 (1939).

Calystegia Catesbeiana Pursh was regularly misinterpreted as a variation of *Convolvulus sepium* L. until in 1939 I secured a photograph of Pursh's type (see Tryon, l. c. pl. 557, fig. 3), when it became apparent that it is the densely pubescent and terminally

[1] The engraving of these plates made possible through a gift from Mr. Bayard Long.

elongate and often twining southern extreme of the white-flowered *Conv. spithamaeus*. Gray and everyone else was misled by Pursh's "C. volubilis, tomentosa" and his "Flowers large, purple" into supposing that Pursh had a very pubescent extreme of the regularly twining and, with us, oftenest roseate-flowered *Convolvulus sepium*. Consequently, although he had no material (see Tryon, l. c. 422), Gray, in publishing *Calystegia sepium*, var. *pubescens*, cited as an absolute synonym of it *C. Catesbeiana*. In his Man. ed. 5 the species of *Calystegia* were: 1. *C. sepium;* 2. *C. spithamaea*. Under *C. sepium* with "the typical form *glabrous* throughout (Convolvulus sepium, and C. repens, *L.*)" Gray added

> "Var. PUBESCENS is a downy form, in the young state approaching the next. (C. Catesbyana *Pursh*.)."

In other words, *Calystegia sepium*, var. *pubescens* was a renaming, as a variety, of *C. Catesbeiana* Pursh and it had no other basis. As the first varietal name used for the latter it must be taken up under the International Rules. The fact that later, in Syn. Fl. ii[1]. 215 (1878), Gray, still not knowing Pursh's type, reduced his own *Calystegia sepium*, var. *pubescens* to his *Convolvulus sepium*, var. *repens* (L.) Gray[2] does not alter the situation, as Tryon, l. c. 422, assumed. Gray, in the Synoptical Flora also included, as a synonym of his inclusive var. *repens*, *Calystegia Catesbeiana* Pursh, for he still supposed it a variation of *Convolvulus sepium* with "herbage from minutely to tomentose-pubescent", "minutely" belonging to *Conv. repens* L., "tomentose-pubescent" to var. *pubescens* (*Calyst. Catesbeiana*). The same interpretation of *Calyst. sepium*, var. *pubescens* (i. e. *C. Catesbeiana*) was made when *Conv. sepium*, var. *pubescens* (Gray) Fernald was published in RHODORA, x. 55 (1908). It was not until we had the photograph of Pursh's type that we realized that his *Calystegia Catesbeiana* did not have "Flowers . . . purple" and that, in reality, it is the southern montane extreme of white-flowered *Convolvulus spithamaeus*. As the first varietal name for the plant, var. *pubescens*, clearly based on *Calystegia*

[2] Although the combination *Convolvulus sepium*, var. *repens* is regularly cited as starting with Gray, Syn. Fl. N. Am. ii[1]. 215 (1878), it was earlier and properly published by Coleman in his Cat. Fl. Pl. So. Pen. Mich. (Kent Sci. Inst. Pub. no. 2), 30 (1874). Coleman should, therefore, be cited as author of the combination.

Catesbeiana, must stand, unless some earlier varietal name for it is found. The name *Conv. spithamaeus*, var. *Catesbeianus* has great merit and is historically clarifying but it is a later varietal name.

Convolvulus sepium L., forma **malachophyllus,** f. nov., foliis cordato-ovatis plerumque 3.5–4 cm. latis utrinque velutino-pilosis; caule pedunculis bracteisque tomentulosis; corollis roseis.—Type from Wickford, Rhode Island, June 17, 1908, *E. F. Williams* in Herb. Gray.

The type, along with several other specimens from a broad area—Anticosti Island to Illinois, Missouri and New Jersey—was distributed as *Convolvulus sepium*, var. *pubescens* (Gray) Fernald; but, as explained in the discussion of *C. spithamaeus*, var. *pubescens*, the nomenclatural basis of that name was badly confused. Forma *malachophyllus* is the very pubescent extreme, allied to *C. sepium*, forma *coloratus* Lange, the roseate-flowered color-form (including var. *americanus* Sims and var. *communis* Tryon) which in America is more frequent than typical white-flowered *C. sepium*, the latter in Europe more common than the roseate-flowered. In view of the fact that approximately 50% of the Eurasian material, there regularly treated as true *C. sepium*, has the leaf of var. *americanus* Sims, as treated by Tryon in Rhodora, xli. 420 (1939), while the other half of the specimens from Eurasia have the leaf of var. *communis* Tryon, l. c. 419, and many American specimens show both types of leaf on the same plant, I have reluctantly given up the effort to keep them apart. I am, however, maintaining var. *fraterniflorus* Mackenzie & Bush as a good geographic variety, not because it has a white corolla, but because the leaf-sinus is distinctive. In all Eurasian material before me (except 1 sheet) and in all American, except for var. *fraterniflorus*, the sinus is U- or V-shaped, with sloping sides. In var. *fraterniflorus*, occurring from Pennsylvania to North Dakota, south to Virginia, Kentucky and Arkansas, all well displayed leaves show a strongly quadrate or nearly square sinus, with parallel sides.[1] This character seems very real. It reappears in a single sheet from Nippon, *Kakuo Uno*, no. 24,144, collected August 17, 1939. From this specimen

[1] Unfortunately the leaf from a topotype shown by Tryon, l. c. pl. 558, fig. 6. has both basal lobes with inner margins folded back, thus obscuring the quadrate sinus.

the familiar range, temperate eastern North America and temperate eastern Asia, is indicated. The sheet from Nippon was distributed as *Calystegia subvolubilis* G. Don, Gen. Syst. iv. 296 (1838), which was a mere transfer of *Convolvulus subvolubilis* Ledeb. Fl. Alt. i. 222 (1829) and Icon. iii. 6, tab. 205 (1831); but *Conv. subvolubilis*, from Dahuria, is wholly different.

Another very striking variety of *Convolvulus sepium* is locally naturalized in western Nova Scotia. Typical *C. sepium* has the leaves acute or acutish and longer than broad, the ovate acute or acutish paired bracts 2–3.5 cm. long, and the white or roseate corolla 4.5–8 cm. high. In western Nova Scotia there also occurs an extreme with suborbicular to round-ovate leaves with blunt to rounded apex, the bracts blunt or round-tipped and only 1.5–2 cm. long, and the white corolla only 4–4.5 cm. high. This seems to be the local Dalmatian var. *dumetorum* Pospichal, Fl. Oesterreich. Küstenlandes, ii. 490 (1898). The two collections are as follows, both from Nova Scotia and distributed as *C. sepium:* roadsides, waste places and ballast-lands, Yarmouth, July 24, 1920, *Long & Linder*, no. 22,326; near a house, grassy or bushy roadsides, Barrington, *Fernald, Long & Linder*, no. 22,327. This variety, occurring near ports, evidently came in shipping from the Adriatic.

Convolvulus pellitus Ledeb., forma **anestius,** stat. et nom. nov. *Calystegia pubescens* Lindl. in Journ. Roy. Hort. Soc. i. 70, with fig. (1846); *Convolvulus pubescens* (Lindl.) Thellung in Viertelj. Naturf. Ges. Zurich, lii. 459 (1907), not *Conv. pubescens* Willd. (1809). *Volvulus japonicus* (Thunb.) Farwell, var. *pubescens* (Lindl.) Farwell in Am. Midl. Nat. xii. 130 (1930).

Convolvulus pellitus, forma *anestius* is the weedy double-flowered plant which has erroneously passed as a form of *C. japonicus* Thunb. That plant (the *Calystegia japonica* (Thunb.) Choisy or *Calysteg. sepium* (L.) R. Br., var. *japonica* (Thunb.) Makino) is, as Dr. Hiroshi Hara clearly demonstrated to me when he spent two years at the Gray Herbarium, wholly different: glabrous, with much longer leaves with 10 to 12 pairs of evident lateral veins, longer bracts up to 3 cm. long and with cordate bases, and the corolla as large as in *Conv. sepium* L. *C. pellitus* Ledeb. Fl. Alt. i. 223 (1829) and Icones, iii. 6, t. 206 (1831) and its double-flowered forma *anestius*, on the other hand, have the

stems and leaves densely soft-pubescent; the subtruncate-based leaves much smaller and with only 3–6 pairs of evident lateral veins; the bracts 1–2.5 cm. long and only gradually rounded (not cordate) at base; the corolla only 4–4.5 cm. high. Typical *Conv. pellitus* with normal simple corolla is rare with us as a weed; the only specimen I have seen (from Massachusetts) coming from an area where waste from woolen-mills abounds. It could have had a quite different origin with us from the common double-flowered plant.

The latter was first noted, apparently, when Lindley described and illustrated it as *Calystegia pubescens* in 1846, Lindley saying:

> "Raised from a very small portion of the root found in a dead Paeony root, in Box No. 22, from Mr. Fortune's mission in China. The box was sent from Shanghai, and stated to contain a plant of the double Convolvulus, which was supposed to be dead when received at the Garden in June, 1844.
>
> This curious plant approaches very nearly to the C. sepium or larger bindweed of our English hedges, from which it differs in having firmer and smaller leaves, much narrower bracts, and a fine pubescence spread over every part. It is the first plant of its order that has been mentioned as producing double flowers. They are about as large as those of a double Anemone, but the petals are arranged with the irregularity of the Rose; they are of a pale very delicate pink, and remain expanded for some days. The calyx is quite unchanged. The exterior petals are very much lacerated and irregular in form; those next the centre are narrow, drawn together into a kind of cone; the next central are completely concealed by those without them, and diminish until they are mere scales, analogous to those which may be found in the first buds which burst in the spring. Not a trace can be found of stamens or pistil."

The same year Lindley essentially reproduced his first account and published a colored plate in Bot. Reg. xxxii. t. 42 (1846), this plate and the account repeated by others. Comparison of Lindley's description and plate with Ledebour's account and beautiful plate of *Convolvulus pellitus* indicates that they are of the same species. However, *Index Kewensis* tells us that *Calystegia* "pubescens, Lindl. . . . = hederacea". *Calystegia hederacea* of Wallich, Cat. was a mere nomen but the Wallich material so named was the basis of *Convolvulus Wallichianus* Spreng. Syst. iv. Cur. Post. 61 (1827), not *Conv. hederaceus* L. (1753). But, obviously, *Conv. Wallichianus* had nothing in common with *Calyst. pubescens* Lindl. The former is very slender and quite glabrous ("utrinque glabris"—Spreng. instead

of "villosus"—Ledeb.), with petioles one half to quite as long as the membranaceous leaf-blade (instead of many times shorter than the firm and thick blade); the broadly hastate base three fourths as broad as to broader than (instead of one third to one half as broad) length of blade; the corolla much shorter.

Convolvulus pellitus, forma *anestius* (homeless) must have been much more in cultivation in the past than at present in the United States. Otherwise it would be most difficult to account for its appearance and spread in abandoned or fallow fields or waste places, on roadsides, etc.; for, producing no seed, it must depend on the unusual vigor (see Lindley's comment) of the slender subterranean parts for propagation. In the Gray Herbarium and that of the New England Botanical Club 37 different stations, all the way from eastern Maine to Michigan, Missouri and Tennessee, are represented, the earliest collection made in 1877, the latest in 1943.

IPOMOEA PANDURATA (L.) G. F. W. Meyer, forma **leviuscula,** nom. nov. Var. *rubescens* Choisy in DC. Prodr. ix. 381 (1845).

In RHODORA, xx. 65 (1918) Blake pointed out that the TYPE of *Convolvulus panduratus* L., therefore of *Ipomoea panduratа,* is the pubescent-leaved form and that, consequently, the "form with leaves glabrous beneath" is Choisy's var. *rubescens.* Choisy's adjective was unfortunate, for both plants have the stem commonly reddish, but he said "caule rubescente glaberrimo ut et foliis". The glabrous and pubescent forms grow somewhat interchangeably in the same areas, so that one may gather material in the same region (southeastern Virginia for example) of either of them. They do not have the geographic segregation one expects of true geographic varieties. I refrain from taking up for a form which differs from the typical plant in its lack of pubescence, the name given it as a variety, since that name is equally descriptive of both forms and, from my viewpoint, would be an absurdity. This case is another to add to those presented by Fassett in RHODORA, l. 249 (1948). Under the wise provision of the International Rules as they have stood for some decades there is no obligation to take over into a new category a name from another category when it would be wholly misleading. Art. 4 of the Rules specially urges us "to avoid or

to reject the use of . . . names which may cause error or ambiguity or throw science into confusion".

A New Polemonium from eastern Pennsylvania (Plates 1144 and 1145).—When in 1892 the late Dr. Britton described the localized *Polemonium Van-Bruntiae* Britton in Bull. Torr. Bot. Cl. xix. 224, pl. 131 (1892) it came as a surprise that in the woodlands of the Atlantic States there was a species so distinct from the much commoner *P. reptans* L. Now that *P. Van-Bruntiae* is well known at scattered spots all the way from western Vermont and New York to the upland of West Virginia[1], Mr. Bayard Long comes forward with another endemic, as yet known only in one limited area of alluvial woods in Montgomery County, Pennsylvania. Growing with the common blue-flowered *P. reptans*, the new plant is strikingly unlike it in many characters. Some years ago Mr. Long referred the plant to me for description, but in deference to others who work primarily on the *Polemoniaceae* I, naturally, refrained from entering polemics over a genus said by some to be named for Polemon of Athens, a Greek philosopher, but by Pliny said to come from *polemos* (war). Now, however, since two specialists on the group have definitely labeled the new plant *P. reptans*, I no longer feel it necessary to withhold publication.

Polemonium reptans (plate 1145, fig. 1), many times illustrated, has the thinnish middle and upper cauline leaves with acute or acutish leaflets; corolla deep blue, 1–1.6 cm. high, completely overtopping the stamens; the style included or barely exserted; the calyx-lobes lanceolate to lance-triangular and acute or acutish. *P. Longii* (plate 1144), on the other hand, has the thick oblong or oblong-oval leaflets obtuse and often bluntly lobulate toward the summit; the calyx-lobes bluntish and broader; corolla red-purple, 7–8 mm. high, much exceeded by the stamens, the style obsolete.

In its long-exserted stamens *Polemonium Longii* is, perhaps, more nearly allied to *P. Van-Bruntiae* (plate 1145, figs. 2 and

[1] The old-fashioned Jacob's-ladder of gardens, *Polemonium caeruleum* L., brought to our gardens from Europe, is occasional in waste and I find specimens of it from so far away from Vermont as rubbish-heaps of Gaspé Co., Quebec, and identified incorrectly by specialists on the group as *P. Van-Bruntiae!* Other perfectly typical *P. caeruleum*, derived from gardens in New Hampshire and originally with correct identifications, has twice been incorrectly annotated as *P. reptans*.

3), but it differs from that species as much as it does from *P. reptans*. *P. Van-Bruntiae* has the leaflets tapering to acute or acuminate tips; those of *P. Longii* are obtuse and often lobulate. The corollas of *P. Van-Bruntiae* are blue-purple and 1.2–1.5 cm. long, those of *P. Longii* red-purple and only 7–8 mm. high. During anthesis the calyx of *P. Van-Bruntiae* is 8–12 mm. long, that of *P. Longii* 5–6 mm. long and with blunter and shorter lobes; the anthers of *P. Van-Bruntiae* are 1.8–3 mm. long, the rounder anthers of *P. Longii* 1–1.3 mm. long. In *P. Van Bruntiae* the style is always exserted 3–10 mm., in *P. Longii* obsolete.

In any other genus such characters are specific. Surely, if *Polemonium Longii* is only *P. reptans* with every character different, it is useless to consider the recognition of specific differences in the family (in *Phlox* for example). The fact that it occurred with *P. reptans* is not an argument that it *is* that species. When *P. Van-Bruntiae* chooses a similar habitat we do not call it also *P. reptans;* nor, simply because they both live in Philadelphia and work at the same institution do we consider the discoverer of *Polemonium Longii* identical with the most prolific writer on that group. It is, of course unfortunate that all the material of the newly proposed species was collected at a single station twenty-three years ago and the type-station later destroyed. Now that attention is called to it and its distinctive characters illustrated many keen botanists will be on the look-out for it. With this possibly polemical introduction I venture to describe

POLEMONIUM **Longii,** sp. nov., TAB. 1144, a *P. reptante* differt foliis crassioribus, foliolis oblongis vel oblongo-ovalibus obtusis plerumque ad apicem 2–3 lobulatis; calycibus 5–6 mm. longis lobis late deltoideis; corollis roseo-purpureis 7–8 mm. longis; staminibus valde exsertis, antheris reniformi-globosis 1–1.3 mm. longis; stylo obsoleto.—Montgomery County, PENNSYLVANIA: alluvial woods along Wissahickon Creek, west of Fort Washington, May 17, 1925, *Bayard Long*, no. 32,357 (TYPE in Herb. Gray.; ISOTYPE in Herb. Phil. Acad.).

In PLATE 1144 all figures are from the TYPE of POLEMONIUM LONGII: FIGS. 1 and 2, portions of inflorescence, × ca. 1; FIG. 3, cauline leaf, × ca. 1; FIG. 4, flowers, × 3; FIG. 5, calyces, × 3.

In PLATE 1145 FIG. 1 shows an inflorescence and upper leaves, × 1, of P. REPTANS L. from along Cattaraugus Creek, Collins, Erie County, New York, *Anne E. Perkins*, no. 68; FIGS. 2 and 3, an inflorescence and cauline leaves,

× 1, of P. Van-Bruntiae Britton, from vicinity of North Harpersfield, Delaware County, New York, *Topping*, no. 182.

Phlox nivalis Lodd. ex Sweet, forma **roseiflora,** f. nov., corollis roseo-purpureis.—Type from open dry sandy woods near North, Orangeburg County, South Carolina, April 20, 1932, *Weatherby*, no. 6109 in Herb. Gray. Other material represented from Virginia to Florida and Alabama.

Typical *Phlox nivalis*, as the name implies and as shown in the original plate of Loddiges, has the corolla white. All colonies we have seen in southeastern Virginia (5 stations in Nansemond, Southampton and Greensville Counties) have consistently rose-purple or magenta corollas and some specimens from North Carolina, South Carolina, Florida and Alabama show in the dry material lingering purple or deep rose in the fading flowers or have memoranda recording such color. This difference of color of the fresh flowers is so striking that to those who know the Virginian plant in the field the specific name seems quite inappropriate. If one were after material for a rockery, it would be desirable to know whether the flowers are white or magenta!

P. subulata L., var. Brittonii (Small) Wherry, forma **australis** (Wherry), stat. nov. *P. subulata australis*, "var. nov.", Wherry in Bartonia, no. 11: 27 (1929).

In parallel columns on the same page Wherry published *Phlox subulata australis* as a variety with "Corolla normally deep purple" and *P. subulata brittonii*, based on *P. Brittonii* Small in Bull. Torr. Bot. Cl. xxvii. 279 (1900), this with "Corolla normally lavender white" and with very slight stated differences in measurements; both from the southern Appalachians. They seem to be color-forms rather than true geographic varieties and I am maintaining for the inclusive variety the earliest trivial name given these plants, Small's description and comparative notes being remarkably clear and to the point.

P. bifida Beck, var. **cedaria** (Brand), comb. nov. *P. Stellaria* Gray in Proc. Am. Acad. viii. 252 (1870). *P. Stellaria*, var. b. *cedaria* Brand in Engler, Pflanzenr. iv^{250}. 75 (1907). *P. bifida stellaria* (Gray) Wherry in Bartonia, no. 11: 34 (1929).

The glabrous or glabrescent and nonglandular mostly more southern variety of *Phlox bifida* was originally described from "'Cliffs of Kentucky River (probably above Lexington), in the

fissures of the most precipitous rocks', found only by the late Dr. Short, May 1, 1829 . . . Named from the resemblance to a *Stellaria* both in foliage and blossoms". Wherefore, since Brand regularly capitalized the initial letter of substantives used as specific names (*Gilia Sonorae*, "Im Staate S o n o r a", and *G. Jassajarae* Brand from "Jassajara Hot Springs") it is probable that he did not consult Gray's original account of *P. Stellaria*, for he treated the specific name as an adjective and incorrectly (by the rule he followed) decapitalized it. His *P. Stellaria*, var. *cedaria* was based upon Gattinger's material from Tennessee: "Cedar Barrens bei Lanergie? (Gattinger)", the query because he could not read Gattinger's LAVERGNE, which is clearly written on the labels of two fine sheets in the Gray Herbarium.

Brand evidently saw very inadequate or meagre material from Lavergne, for his description indicated the short leaves of the flowering shoots only, rather than the much longer leaves of the well developed vegetative branches:

> "Var. b. **cedaria** Brand. n. var. Folia 10–20 mm longa. Calyx et pedicelli glabriusculi.
> "T e n n e s s e e : Cedar Barrens bei Lanergie? (Gattinger, Herb. München.)"

One of the Gattinger sheets in the Gray Herbarium, no. 2150, coll. May 1, 1880, is of a small piece with three flowering branches on which the leaves are 0.8–1.5 cm. long, while the sterile leafy branches have them up to 3 cm. long. The other, a very large specimen covering the herbarium-sheet and bearing detailed notes by Gattinger, is similar but a very full specimen, collected June 21, 1880. The leaves of the flowering branches are as in the smaller piece, some of those of the vegetative shoots up to 4.5 or 5 cm. long.

Wherry, l. c., 29, discussing the inclusive *Phlox bifida*, quickly disposed of var. *cedaria*, saying "Brand's supposed variety, *P. stellaria cedaria*, is still less acceptable, being based on a specimen from which mature leaves had evidently been broken off [or were not represented]". Therefore, by his reasoning, although the glabrescent and nonglandular *P. Stellaria*, var. *cedaria* was on p. 29 "Brand's supposed variety", on p. 34 it was one of the "varieties which exhibit sufficient geographic segregation to deserve nomenclatorial treatment" and we find the combination

"**Phlox bifida stellaria** (Gray) Wherry, comb. nov." based on *P. Stellaria* Gray (1870); but, whereas Gray's TYPE and only cited specimen was "found only by the late Dr. Short, May 1, 1829", the plant is by Wherry now "Typified by a specimen collected at Camp Nelson, Jessamine Co., Ky., by E. T. W. April 11, 1928". The International Rules of Botanical Nomenclature are definite: we cannot reject the earliest varietal name for a variety and substitute for it an older name which was published only as specific. By the Rules the combination *P. bifida*, var. *cedaria* stands.

P. DIVARICATA L., forma **Coulteri,** f. nov. Unnamed but defined form of Watson & Coulter in Gray, Man. ed. 6: 355 (1890).

This very remarkable plant was sent to the late Sereno Watson by Dr. John M. Coulter with the accompanying letter:

Crawfordsville, Ind., May 22, '89

Dear Mr. Watson:

Here's a specimen we collected near here the other day. We found quite a patch of it, but most of it past season. It infests a dry, rocky glacial ridge. It is evidently *Phlox*, but I can't find that it has been described.

Yrs. as always
John M. Coulter.

Watson evidently asked why it is not *Phlox divaricata*, for Coulter's reply was as follows:

Crawfordsville, Ind.—
May 30, '89

Dear Mr. Watson:

Yes, we have plenty of *Phlox divaricata* growing all about us, & are perfectly familiar with it. The plant sent you has exactly the foliage cut of *P. divaricata*, but the flowers are so very different. They are very much smaller, & the remarkable abrupt acumination of the petals is unlike any Phlox I ever saw. In *P. divaricata* the petals are broad and notched, or sometimes entire in var. *Laphamii*. Another point in the case is that this is not a single isolated specimen, but there was a large area covered by these plants, all with the same characters. To me the plant looks like a pretty sharp variety of *P. divaricata*.

Yrs. as always,
John M. Coulter

As noted above, Watson & Coulter described this plant as an unnamed form the next year. Wherry in Bartonia, no. 12: 34 (1931), noted it as a form, "**Long-acuminate-lobed**", as dom-

inant near Crawfordsville "and widely known as the 'Crawfordsville form'"; just how "widely known" is not clear. At least, Deam in his Flora of Indiana did not mention it.

On the same page Wherry correctly noted the albino as *Phlox divaricata*, forma *albiflora* Farwell. Subsequently, however, he wrote in Bartonia, no. 16: 40 (1938): "In discussing white forms . . . one name was overlooked: *P. d. candida* Wetzstein. This has priority over *albiflora*, although whether it represented a pallid or an albino plant is not known". The unwary might, from this, think that Wetzstein's name should invalidate the properly defined *P. divaricata*, forma *albiflora* Farwell in Rep. Mich. Acad. Sci. xxi. 369 (1920). But, what Wherry does not bring out, is that *P. divaricata candida* Wetzstein in Proc. Ohio State Acad. Sci. iv. 361 (1906) was a *nomen nudum*, without a single word of description and, therefore, has no status whatever in nomenclature.

P. MACULATA L., forma **immaculata,** f. nov., a *P. maculata* differt caule immaculato; corollis albidis. TYPE: with the abundant purple-flowered plant in an open swamp, Fairfield, Connecticut, July 11, 1902, *E. H. Eames*, no. 180ac, in Herb. Gray.

Forma *immaculata* is the form of ordinarily spotted-stemmed and purple-flowered typical northern *Phlox maculata* in which the purple of stem and corolla are lacking, the stem being green, the corolla white. Specimens are before me from Connecticut and New York.

Brand in Engler, Pflanzenr. iv[250]. 60 (1907) makes *P. suaveolens* Ait. Hort. Kew. i. 206 (1789) the nomenclatural basis for all white-flowered plants of the inclusive species, whether northern or southern, without differentiation, he calling them *P. maculata*, var. b. *suaveolens* (Ait.) Brand and citing also the *P. suaveolens* of Pers. Syn. i. 186 (1805), which was largely the *P. maculata*, var. *candida* Michx. of "Virginia, Carolina", therefore not the few-leaved and relatively low northern plant; and also *P. suaveolens* sensu Ell. Sk. i. 244 (1817), described from Savannah, Georgia (and on the outermost Coastal Plain), 250 miles south of the southern (Piedmont and Alleghenian) limit assigned by Wherry to any form of *P. maculata*. Brand also cited, under his all-inclusive var. *suaveolens*, *P. alba* Moench, Meth. Suppl.

173 (1802) but that was a substitute for *P. suaveolens*. *P. maculata* β. *candida* Michx. Fl. Bor.-Am. i. 143 (1803) was also cited but that belongs to the many-leaved southern variety, Michaux citing it from "Virginia, Carolina". In view of the fact that we do not know just what Aiton had before him as *P. suaveolens*, a cultivated plant, it would be very unwise to use that much misinterpreted name for a color-form of the wholly northern plant.

P. MACULATA L., var. PURPUREA Michx., forma **candida** (Michx.), stat. nov. *P. maculata*, β. *candida* Michx. Fl. Bor.-Am. i. 143 (1803).

I am retaining the first varietal name, properly defined, for the southern tall, many-leaved and more uniformly leafy variety of *P. maculata* which is called var. *pyramidalis* (Smith) Wherry in Bartonia, no. 14: 26 (1932), this based on the binomial *P. pyramidalis* Smith, Exot. Bot. ii. 55, pl. 87 (1806). Since Michaux had already given a clearly defined name for the variety that stands under the International Rules.

PHYSALIS BARBADENSIS Jacq., var. **glabra** (Michx.), comb. nov. *P. obscura* Michx., var. α. *glabra* Michx. Fl. Bor.-Am. i. 149 (1803). *P. barbadensis obscura* (Michx.) Rydb. in Mem. Torr. Bot. Cl. iv. no. 5: 327 (1896).

Michaux's *Physalis obscura* was immediately broken into two varieties: "Var. α. *glabra:* summitatibus et petiolis vix perceptibili pube"; and "—β. *viscido-pubescens*". The latter is perhaps the viscid-villous or -pilose typical *P. barbadensis*, while var. α. *glabra* is the glabrous or glabrescent variety (photograph of the type before me). As the first varietal name it supersedes var. *obscura* (1896) and the two are obviously the same plant.

CHAMAESARACHA **grandiflora** (Hook.), comb. nov. *Physalis grandiflora* Hook. Fl. Bor.-Am. ii. 90 (1834). *Leucophysalis grandiflora* (Hook.) Rydb. in Mem. Torr. Bot. Cl. iv. 366 (1896).

Leucophysalis was treated by Rydberg as a monotypic genus of the Canadian to Hudsonian area of eastern North America, but Dr. Armando Hunziker kindly calls my attention to the fact that it closely resembles similarly white-flowered plants of China and the Andean region; however, he is not ready to separate it from

inclusive *Physalis*. In the close and scarcely reticulate fruiting calyx, the rotate white corolla and some other points it seems to be too near to *Chamaesaracha*. The removal of this species (and some others) from *Physalis* would clarify the generic lines. Otherwise, *Physalis*, passing into *Chamaesaracha*, would be as cumbersome as *Aster* would become if we followed Otto Kuntze and placed in it the large and chiefly North American genus *Solidago*.

PENSTEMON TUBAEFLORUS Nutt., var. **achoreus,** var. nov., a var. typica recedit caule tenuiore 0.6–1 m. alto; foliis coriaceis, majoribus 1–2.5 cm. latis plerumque subacuminatis; cymulis inferioribus longe pedunculatis pedunculo 1.5–8 cm. longo.—Dry old fields, pastures, etc., New England and Ontario, south to Pennsylvania. TYPE from Aroostook County, MAINE: well established in a dry open field near cemetery, Fort Fairfield, July 17, 1939, *G. D. Chamberlain* in Herb. Gray.

True *Penstemon tubaeflorus* Nutt., occurring from Nebraska to eastern Texas, eastward to Mississippi, Tennessee, Indiana and Wisconsin, and slightly adventive to the Atlantic states, has 2–4 pairs of principal cauline leaves distant, submembranaceous and the larger ones 2–4 cm. broad and blunt to subacute, the lower cymules on peduncles only 0.2–1.5 (rarely –3) cm. long. The plant rather generally naturalized in New England and adjacent areas, although with the floral characters of *P. tubaeflorus*, is more slender and usually taller (0.6–1 m. high); its leaves are coriaceous, the pairs less distant, the larger cauline ones only 1–2.5 cm. broad and usually more acuminate; and the lower cymules are on peduncles 1.5–8 cm. long. This plant, var. *achoreus* (without a native land), was established in Maine as early as 1881 and it is now in many old fields throughout much of New England. It has evidently come in from farther west, but its native region is unknown.

P. CANESCENS Britt., forma **villicaulis,** f. nov., internodiis longe villosis.—Occasional in Virginia. TYPE: Fauquier Co., VIRGINIA: top of Oventop Mt., June 13, 1937, *Allard*, no. 3001 in Herb. Gray.

Typical *Penstemon canescens* has the internodes closely cinereous-puberulent; forma *villicaulis* has the stem from base into the inflorescence covered with elongate villi.

P. CANESCENS Britt., forma **Brittonorum** (Pennell), stat. nov. *P. Brittonorum* Pennell in Small, Man. Se. Fl. 1204, 1508 (1933). *P. canescens brittonorum* (Pennell) Pennell in Acad. Nat. Sci. Phila. Mon. i. 222 (1935).

P. BREVISEPALUS Pennell, forma **heterolasius,** f. nov., internodiis inferioribus puberulentis villis elongatis intermixtis.—Scattered through the range of the typical form. TYPE from Nelson Co., TENNESSEE: open roadside bank west of Belltown, May 22, 1933, *C. A. and Una F. Weatherby*, no. 6373, in Herb. Gray.

In typical *Penstemon brevisepalus* the lower internodes are closely puberulent; in forma *heterolasius* abundant long villi are intermixed.

P. AUSTRALIS Small, forma **odontophyllus,** f. nov., foliis rosulatis crenato-dentatis, caulinis valde duplicato-serratis.—Nansemond Co., VIRGINIA: white sand of pine and oak woods and clearings near Cathole Landing, west of Factory Hill, July 18, 1944, *Fernald & Long*, no. 12,468 (TYPE in Herb. Gray.).

Typical *Penstemon australis*, abundant and usually essentially unvarying in the sandy pinelands and oak woods of southeastern Virginia, has the radical leaves entire or nearly so, as are the cauline ones. Forma *odontophyllus*, known from a single station only, has the rosette-leaves regularly crenate-dentate and the cauline ones abundantly and somewhat doubly serrate-dentate. It is known only in overripe fruit. Younger material may show other characters.

GRATIOLA NEGLECTA Torr., var. **glaberrima** (Fern.), comb. nov. *G. lutea* Raf., var. *glaberrima* Fern. in RHODORA, XXXIV. 149 (1932).

GERARDIA, subgen. **Eugerardia** (Benth.), stat. nov. Sect. *Eugerardia* Benth. in Hook. Comp. Bot. Mag. i. 206 (1836).

GERARDIA, subgen. **Otophylla** (Benth.), stat. nov. Sect. *Otophylla* Benth. l. c. 205 (1836).

GERARDIA, subgen. **Panctenis** (Raf.), comb. nov. *Panctenis* Raf. New Fl. ii. 60 (1837). *Aureolaria*, subgen. *Panctenis* (Raf.) Pennell in Bull. Torr. Bot. Cl. xl. 408 (1913).

G. GRANDIFLORA Benth., var. **pulchra** (Pennell), comb. nov. *Aureolaria grandiflora* (Benth.) Pennell, var. *pulchra* Pennell in Proc. Acad. Nat. Sci. Phila. lxxx. 392 (1928).

G. FLAVA L., var. **macrantha** (Pennell), comb. nov. *Aureolaria flava*, var. *macrantha* Pennell in Proc. Acad. Nat. Sci. Phila. lxxiii. 511 (1922).

G. **calycosa** (Mackenz. & Bush), comb. nov. *Dasystoma calycosa* Mackenz. & Bush in Rep. Mo. Bot. Gard. xvi. 105 (1905).

G. PEDICULARIA L., var. **intercedens** (Pennell), comb. nov. *Aureolaria pedicularia* (L.) Raf., var. *intercedens* Pennell in Torreya, xix. 207 (1919).

G. PEDICULARIA L., var. **austromontana** (Pennell), comb. nov. *Aureolaria pedicularia* (L.) Raf., var. *austromontana* Pennell in Proc. Acad. Nat. Sci. Phila. lxxi. 268 (1920).

(To be continued)

CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD UNIVERSITY—NO. CLXIX.

Part II. STUDIES OF EASTERN AMERICAN PLANTS

M. L. Fernald

(*Continued from page 85*)

5. Some Northern Astereae (Plates 1146–1150)

Solidago Purshii, not S. chrysolepis (Plate 1146).—Mr. David Erskine kindly calls to my attention a lapse in my recent analysis of the nomenclature of the boreal virgate goldenrod which long but incorrectly passed as *Solidago uliginosa* Nutt. In Rhodora, xlix. 294 (1947), in pointing out some of the morphological characters which separate this essentially northern and chiefly calcicolous species from the mostly more southern and oxylophytic true *S. uliginosa* (*S. neglecta* Torr. & Gray; *S. uniligulata* (DC.) Porter), I overlooked the ultimate result, as regards the former species, of an analysis of a very confused situation regarding the publication and interpretations of *S. humilis* Pursh, Fl. Am. Sept. 543 (1814), not Miller (1768), which I had published in Rhodora, x. 88–91 (1908).

There, unaware that the type of *Solidago uliginosa* Nutt. was characteristic *S. neglecta*, I was following the traditional interpretations, and was demonstrating that the technical type of *S. humilis* Pursh, not Miller, is the small Newfoundland specimen collected by Banks. It, therefore, followed that, when Porter substituted for the name *S. humilis* Pursh, without citation of anything but the Pursh reference, the name *S. Purshii* in Bull. Torr. Bot. Cl. xxi. 311 (1894), the latter name, nomenclaturally,

went back to the Pursh type (the Banks specimen), our FIG. 1, × ca. ½. Immediately to confuse the situation, however, the name *S. Purshii* was taken up, as in Britton & Brown, Ill. Fl. iii. 337, fig. 3687 (1898), for the wholly different, low and glutinous plant, quite unknown from Newfoundland, which had been erroneously passing as "*S. humilis*"; this continental narrow-leaved glutinous plant apparently correctly called *S. racemosa* Greene, Pittonia, iii. 160 (1897).

Although in 1908 I had the typification of *Solidago humilis* Pursh (= *S. Purshii* Porter) correctly worked out, I had forgotten in 1947 my conclusion from the very complicated bibliography. It is, however, quite clear, as Mr. Erskine indicates, that the name SOLIDAGO PURSHII Porter (1894) must be used for the long misnamed boreal and calcicolous "*S. uliginosa*" instead of the much later *S. chrysolepis* Fernald in Ottawa Nat. xix. 168 (1905). Banks collected in southeastern Labrador and along the north-eastern coast of Newfoundland. His plant, TYPE of *S. humilis* Pursh, not Miller, consequently of *S. Purshii* Porter, with the annotations by Asa Gray discussed by me in 1908, is shown, × ca. ½, as FIG. 1. Beside it is a modern specimen from north-eastern Newfoundland (Quirpon Island, *Fernald & Long*, no. 29,114), × 1 (FIG. 2), with the summit of the thyrse shown, × 3, as FIG. 3. Both plants are dwarfs from bleak habitats but that they are reduced specimens of the boreal species which for nearly a century incorrectly passed as "*S. uliginosa*" can scarcely be questioned.

ASTER AZUREUS Lindl., forma **laevicaulis,** f. nov., caulibus laevi-usculis sublucidis.—TYPE from ILLINOIS: Fountaindale, Winne-bago Co., 1867, *M. S. Bebb* in Herb. Gray.

An isotype of *Aster azureus* from St. Louis, *Drummond*, shows it to be the form with harshly scabrous stem, which was separated from the more widely dispersed plant with smooth and lustrous stems as *A. azureus scabrior* Engelm. ex Burgess in Small, Fl. Se. U. S. 1215 (1903). Engelmann, presumably realizing that the Drummond type was the form with "extremely rough" stem, seems not to have published the name. This, typical *A. azureus*, is apparently less abundant than the smooth-stemmed forma *laevicaulis*. At least, in the Gray Herbarium there are twice as many specimens of the latter as of the former.

A. AZUREUS Lindl., var. **poaceus** (Burgess), stat. nov. *A. poaceus* Burgess in Small Fl. Se. U. S. 1215, 1339 (1903).

As Burgess originally said, his *Aster poaceus* "Represents the extreme of attenuation among the kindred of *A. azureus*". Engelmann had it as an unpublished variety of *A. azureus* from Texas; Hasse distributed it from Arkansas as "a form" of *A. azureus:* and Sereno Watson marked other Hasse material as "*A. azureus*, var.—Chapman, f. Hasse". I agree with Engelmann and Chapman.

A. CILIOLATUS Lindl., forma **comatus** (Fern.), stat. nov. *A. Lindleyanus* T. & G., var. *comatus* Fern. in RHODORA, vi. 142 (1904).

A. TARDIFLORUS L., forma **vestitus** (Fern.), stat. nov. Var. *vestitus* Fern. in RHODORA, i. 188 (1899).

A. PUNICEUS L., forma **candidus,** f. nov., ligulis albis.—Washington Co., NEW YORK: wet place, J. D. Pierce's farm, West Road, Welch Hollow, north of Fort Anne, September 26, 1916, *Stewart H. Burnham* in Herb. Gray.

Forma *candidus* is the albino of typical *Aster puniceus.* It should not be confused with *A. puniceus*, var. *lucidulus* Gray, forma *albiflorus* R. Hoffm. in Proc. Bost. Soc. Nat. Hist. xxxvi. 339 (1922), which is the albino of *A. puniceus*, var. *firmus* (Nees) Torr. & Gray, from which I am unable to separate var. *lucidulus*, except as a minor form. When, in Am. Midl. Nat. xxvi. 414 (1941), Shinners published the combination *A. puniceus*, f. *albiflorus* (Farw.) Shinners, based on *A. puniceus*, var. *albiflorus* Farwell in Rep. Mich. Acad. Sci. xvii. 171 (1916), he apparently overlooked the fact that the identical formal name may not be used twice within a single species.

A. PUNICEUS L., forma **demissus** (Lindl.), stat. nov. Var. *demissus* Lindl. in Bot. Reg. xix. t. 1636 (1833).

A. PUNICEUS, var. FIRMUS (Nees) T. & G., forma **lucidulus** (Gray), stat. nov. *A. puniceus*, var. *lucidulus* Gray, Syn. Fl. i^2. 195 (1884). *A. lucidulus* (Gray) Wiegand in RHODORA, xxvi. 4 (1924).

I am quite incapable of separating *Aster lucidulus* as a species or even as a geographic variety. Its range essentially coincides with that of var. *firmus* (var. *laevicaulis* Gray), the only tangible difference being its entire, instead of more or less serrate, leaves.

A. ericoides L., forma **prostratus** (Ktze.), stat. nov. *A. multiflorus* Ait. β. *prostratus* Ktze. Revis. Gen. Pl. i. 313 (1891).

Forma *prostratus*, as described by Otto Kuntze from Nebraska, "Caulis prostratus ramis erectis" is a very depressed and wind-swept form, strikingly unlike the sturdy upright plant. Such closely matted extremes occur in bleak habitats (like crests of sea-cliffs) in New England.

A. ericoides L., forma **exiguus** (Fern.), stat. nov. *A. multiflorus* Ait., var. *exiguus* Fern. in Rhodora, i. 187 (1899).

Although the combination *A. exiguus* (Fern.) Rydb. in Bull. Torr. Bot. Cl. xxviii. 505 (1901) rests nomenclaturally on *A. multiflorus*, var. *exiguus*, the plant Rydberg describes can hardly be the same. Forma *exiguus* is the ascending plant with heads mostly solitary at the tips of the branches.

A. coerulescens DC., var. **angustior** (Wieg.), comb. nov. *A. praealtus* Poir., var. *angustior* Wiegand in Rhodora, xxxv. 24 (1933).

For discussion of the specific names involved see Shinners in Rhodora, li. 91 (1949).

A. coerulescens, var. **subasper** (Lindl.), comb. nov. *A. subasper* Lindl. in Hook. Comp. Bot. Mag. i. 97 (1835). *A. salicifolius* Ait., var. *subasper* (Lindl.) Gray, Syn. Fl. i^2. 188 (1884). *A. praealtus* Poir., var. *subasper* (Lindl.) Wieg. in Rhodora, xxxv. 24 (1933).

Aster foliaceus or A. crenifolius in the Northeast—which? (Plates 1147–1150).—In Rhodora, xvii. 13–16 (1915) I pointed out that *Aster foliaceus* Lindl. in DC. Prodr. v. 228 (1836), described from Unalaska with leaves oblong-lanceolate, clasping and subserrate, the heads terminating axillary branches, the phyllaries ("invol. squamis") foliaceous and glabrous, is very characteristic also in Labrador, Newfoundland, eastern Quebec and northern New England. At that time I noted some varieties differing from the variations which occur in cordilleran North America. Typical *A. foliaceus* sensu Fernald (as well as Lindley, Gray and others) and its vars. *arcuans* and *subpetiolatus* Fern. l. c. are widely distributed in the Northeast (just as are many other species in many genera which are also Alaskan). Var. *subgeminatus* Fern. l. c. 16, with the lower leaves having long

subpetiolate bases and the involucre only 5–6 mm. high and of very slender nonfoliaceous phyllaries, as opposed to sessile leaves and broad foliaceous phyllaries 8–15 mm. long, is wholly distinct, being the endemic western Newfoundland representative of *A. ciliolatus* Lindl., *A. subgeminatus* (Fern.) Boivin in Naturaliste Canad., lxxv. 211 (1948). The rarest and most doubtful (probably extinct) eastern variety under *A. foliaceus* is var. *crenifolius* Fern. l. c. 15, an extreme plant (PLATE 1147) ,differing from the others in its elliptic and bluntish short leaves pilose on midrib and stronger nerves beneath (FIG. 2, × 5) and with closely crenate margins. This extreme plant, doubtfully belonging with the others, and perhaps of hybrid origin, was found by Collins, Pease and the writer forty-five years ago as a single clone on the treacherously overhanging crest of a deeply undercut and rapidly disintegrating soft red sandstone margin of the Gulf of St. Lawrence, where the sea was so rapidly breaking down the coast-line that the inhabitants were moving farther back. It was presumably long ago destroyed.

Although all these plants of the East were treated by me as varieties of *Aster foliaceus*, a more recent and much younger student, who has never seen the eastern plants growing, has announced that

> "I noticed that the eastern American plants which had been referred to *A. foliaceus* Lindl. could generally be recognized at a glance, purely by their habit. These specimens furthermore, were in some respects (such as the commonly toothed leaves) nearer to *A. douglasii* Lindl. than to *A. foliaceus*.
>
> "Upon re-examination of these eastern plants, I am convinced that they should be distinguished specifically from their western relatives."—Cronquist in Bull. Torr. Bot. Cl. lxxiv. 142 (1947).

Consequently, we get the following deduction:

"**Aster crenifolius** (Fern.) Cronquist, comb. nov. *A. foliaceus* var. *crenifolius* Fern. (Rhodora) **17: 15. 1915.**"

There is the verdict of one who unites most morphologically distinct species in *Antennaria*[1], who similarly treats two remarkably distinct and geographically and ecologically usually separated species of *Solidago*[2], who can see no difference between the

[1] For discussion of such work see Fernald in RHODORA, xlvii. 221–235 and 239–247, plates 912–962 (1945)—repr. as Contrib. Gray Herb. no. clvii, pt. 1.

[2] For discussion see Fernald in RHODORA, xlix. 294–297 (1947); also this no. p. 93.

Atlantic North American *Petasites palmatus* and the abundantly distinct Pacific American *P. speciosus* (Nutt.) Piper[1], and whose pronouncements on many other *Compositae* have shown a "lumping" tendency beyond the comprehension of those with a vastly greater experience with the plants concerned. Can it be that the pendulum is swinging as far or farther in the opposite direction? It, at the time of this writing, being the Christmas season with its expected charity toward all, I will defer to another time further discussion of the amazing treatments of *Petasites* and some other genera. The seemingly conclusive statement, however, that in "the eastern plants [of *Aster foliaceus*] . . . their greatest similarity is not to *A. foliaceus* proper" (Cronquist, p. 142) needs immediate consideration, lest credulous readers adopt the not too carefully made conclusion.

If our eastern plant really differs from *Aster* "*foliaceus* proper" in "habit", in being "recognized at a glance" and in "commonly toothed leaves", it is noteworthy that so much of it should have the leaves entire or barely few-toothed, and should thus fit Lindley's definition of his *A. foliaceus* with leaves "subserratis". It is a striking fact also that sheet after sheet of specimens of the Alaskan plant, *A.* "*foliaceus* proper", can be placed side-by-side with sheets from Labrador, Newfoundland or eastern Quebec so that, if the labels are covered, anyone of ordinarily keen perception would be incapable of saying whence they came. And the very practical eye of the camera would be equally unable to detect a specific difference. Thus, in PLATE 1148, FIG. 1 is the summit of a plant, × 1, from the type-region of *A. foliaceus*, marked by Cronquist *A. foliaceus* var. *typicus*, this specimen being *Jepson*, no. 307, from Unalaska; FIG. 2 is the summit, × 1, of *Fernald & Wiegand*, no. 4114[a] from Bonne Bay, Newfoundland, originally called *A. foliaceus* but annotated by Cronquist as *A. crenifolius*. What is the *specific* difference, except that the Newfoundland plant has entire leaves, which is against the rule for *A. crenifolius*? In PLATE 1149, FIG. 1 is the summit of a plant from Le Conte Bay, Alaska, *Mr. & Mrs. E. P. Walker*, no. 880 (also validated as var. *typicus*); but beside it is a photograph (FIG. 2) of the summit of a specimen from Rivière Cap Chat, Matane County, Quebec, *Fernald & Smith*, no. 26,047. Again

[1] See Cronquist in RHODORA, xlviii. 125 (1946).

why are they of different species? In PLATE 1150, FIG. 1 is from the summit of a plant from Lituya Bay, Alaska, *R. H. Bates*, no. 151, also validated by Cronquist as var. *typicus:* while FIG. 2 is the lower leaf-surface, × 5. Beside it, as FIGS. 3 and 4, are a bit from the summit of *Fernald & Wiegand*, no. 4129 from Blanc Sablon, at the western entrance to the Straits of Belle Isle, this originally and correctly identified as *A. foliaceus* but that objectionable identification "corrected" by Cronquist to *A. crenifolius:* FIG. 4 being the lower leaf-surface, × 5. Take your choice; to most botanists they are of the same boreal plant.

Whatever typical *Aster crenifolius* (a portion of the TYPE, × 1 and the midrib beneath × 5, as PLATE 1147) may have been or may prove to be, whether a hybrid of *A. puniceus* or a more stable plant, most of the plants of our Northeast seem to me, as they did when I first studied them, quite indistinguishable from *A.* "*foliaceus* proper" or *A. foliaceus*, var. *typicus* of Alaska. Those who see "at a glance" a very distinct species in the East, must deduce something tangible before they can be safely followed. The identities of species of the region centering about the Gulf of St. Lawrence with remotely isolated species of the Alaskan area (*Poa eminens* J. S. Presl, *Hordeum brachyantherum* Nevski, *Listera borealis* Morong, *Epilobium glandulosum* Lehm., *Senecio Pseudo-Arnica* Less. and *S. resedifolius* Less., etc. etc.) are so numerous that an identity in *Aster* is to be expected.

A. JOHANNENSIS Fern., var. **villicaulis** (Gray), comb. nov. *A. longifolius* Lam., var. *villicaulis* Gray, Syn. Fl. i². 189 (1884).

Although *Aster johannensis* in its typical form (including *A. gaspensis* Victorin) is a dominant species from southern Labrador to Saskatchewan, south to Newfoundland, Prince Edward Island, northern and western New England, northern New Jersey, New York and southern Ontario, being in large part what has passed as *A. longifolius*, the densely villous var. *villicaulis* is abundant along rivers of eastern Quebec, New Brunswick and northern New England, not being known through the broad range of the species.

A. NEMORALIS Ait., forma **albiflorus** f. nov., ligulis albidis.—MAINE: south shore of Jordan Pond, Mt. Desert Island, September 10, 1894, *E. L. Rand*, TYPE in Herb. N. E. Bot. Club.

At its start the name *Aster nemoralis* Ait. Hort. Kew. iii. 198 (1789) was given as a result of considerable misinformation regarding the plant. The primary diagnosis was accurate enough for the full sheet which has been identified at the British Museum (Natural History) as the TYPE; but the trivial name given, the translation "Wood Star-wort" and the "Obs. . . . *Radius* caeruleus" were most unfortunate for a plant which characterizes sphagnous bogs and has lilac-pink ligules. On account of the supposed woodland-habitat and the blue ligules Willdenow in his Species Plantarum, iii[3]. 2021 (1803) took up *A. nemoralis* for the stiff plant of dry open ground or thin woods, with blue ligules, which had already been described as *A. linariifolius* L. Sp. Pl. 874 (1753); but since Aiton's plant came from Nova Scotia, where *A. linariifolius* is unknown, that interpretation can be dismissed. Other names were early published for the species which Aiton had, but misunderstood: *A. uniflorus* Michx. Fl. Bor.-Am. ii. 110 (1803) "*Hab.* in vastis sphagnosis", but Michaux's name was antedated by *A. uniflorus* Moench. Meth. 602 (1794); *A. ledifolius* Pursh, Fl. Am. Sept. ii. 544 (1814), "In sphagnous bogs and about mountain-lakes . . . rays lilac or reddish-purple", but Pursh's name was illegitimate for he cited as an exact synonym *A. nemoralis* Ait. and as the basis of his *A. ledifolius* β. *uniflorus* the *A. uniflorus* Michx. Everyone who knows the plant in the field agrees that it is not a species of the woods: "rayons violets ou roses . . . charactéristique des tourbières".—Victorin, Fl. Laurent. 612 (1935); "bogs and marshes, lake margins, and dominant on peaty barrens"—Roland, Fl. Nova Scotia, 494 (1947); "Peat bogs and open swamps"—Rand and Redfield, Fl. Mt. Desert, 116 (1894); "**Bog Aster** . . . distinctly the Aster of the Cedar Swamps and cold bogs"—Stone, Pl. So. New Jersey, 759 (1912).

In spite of the misleading name and the presumably incorrect description of the color of the ligules, there is no question that the plant preserved at South Kensington as the TYPE of *Aster nemoralis* otherwise definitely matches the description given by Aiton. Disturbed by the name used by him and by his *blue* ligules, I appealed to Dr. George Taylor, Deputy Keeper at the British Museum. He most kindly sends me beautifully clear photographs, one of the full sheet, one of an enlargement, and I

see at the bottom of the full sheet in my own handwriting "nemoralis", placed there in 1930! Dr. Philipson, in charge of the *Compositae*, compared fragments which I had sent of the Bog-Aster, *A. nemoralis* as generally understood, and of *A. Blakei* (Porter) House, which often grows in low woods, and writes: "The type appears to correspond to Fernald et al. 22805 (. . . 'nemoralis'); not at all to Fernald and Long 2466 (. . . 'Blakei')". It is wisest, therefore, to retain the name *Aster nemoralis* in its established sense. It is hardly more inappropriate than *Solidago nemoralis* Ait. for a species which abounds on dry open and barren habitats.

A. ACUMINATUS Michx., forma **subverticillatus,** f. nov., foliis imis valde reductis, foliis primariis subapproximatis internodiis 1–20 mm. longis, laminis 0.6–1.5 dm. longis.—Frequent through much of the range of the species. TYPE from MASSACHUSETTS: Lincoln, October 5, 1902, *Emile F. Williams* in Herb. Gray.

Aster acuminatus has two strikingly different but freely intergrading forms. Michaux described it "foliis omnibus conformibus" and my memorandum made when I studied the Michaux Herbarium in 1903 was: "The regularly leafy plant". The "regularly leafy plant" has the leaves almost uniformly scattered up the stem, the lower ones only slightly smaller than the median and upper ones, with the upper internodes mostly 1–3 cm. long and the larger blades mostly 0.5–1 dm. long. This typical *A. acuminatus* is shown in Britton & Brown, Ill. Fl. iii. fig. 3789 (1898) and in House, Wild Fl. N. Y. ii. pl. 247 (1920)[1]. A very characteristic illustration of forma *subverticillatus* will be found as *A. acuminatus* in Hooker in Curtis's Bot. Mag. liv. t. 2707 (1827).

A. ACUMINATUS, var. **magdalenensis,** var. nov., foliis regulariter distantibus late ovalibus acutis vel breviter acuminatis.—MAGDALEN ISLANDS, QUEBEC: TYPE from dry clearing, Étang du Nord, Grindstone Island, *Fernald, Bartram, Long & St. John,*

[1] NOTE ON DATES OF ISSUE OF HOUSE'S WILD FLOWERS OF NEW YORK.—In view of the date 1918 on the title-pages of both vols. 1 and 2 of House, Wild Flowers of New York, Univ. N. Y., State Museum, Mem. 15, it is important to note that the printed "Statement", dated from Albany, July 30, 1920, says that at that date "Volume I . . . is now ready for delivery". A similar "Statement", postmarked Dec. 3, 1920, says "It is expected that volume 2 will be issued in the course of three months". However, the copy in the library of the Gray Herbarium was received on the 15th of December, 1920.

July 25, 1912, no. 8159 in Herb. Gray. Other numbers are from Grindstone, Grindstone Island, *Fernald, Long & St. John*, no. 8160, and Ile Brion, *Victorin & Rolland*, no. 9807.

In typical *Aster acuminatus* the principal leaves are oblong-lanceolate to oblanceolate or narrowly subelliptic and long-acuminate, one fifth to scarcely half as broad as long. In var. *magdalenensis* they are broadly oval, nearly half as broad as long, and merely acute or very short-acuminate.

A. UMBELLATUS Mill., forma **intercedens,** f. nov., a forma typica recedit foliis subtus plus minusve pilosis.—TYPE from NEWFOUNDLAND: thicket on barrens at base of the serpentine tablelands, Bonne Bay, August 27, 1910, *Fernald & Wiegand*, no. 4131 in Herb. Gray.

Typical *Aster umbellatus* has the leaves glabrous beneath or merely pubescent along the midrib, but in more exposed situations from Newfoundland and from St. Paul's Island, Cape Breton, to the Mistassini Territory of Quebec (and probably beyond) it frequently has considerable pilosity on the lower surfaces of the leaves. It thus makes a strong approach to the northwestern var. *pubens* Gray, Syn. Fl. i^2. 197 (1884), although the hairs are coarser. The latter plant, when only the most extreme and relatively few representatives from different stations are separated from the mass of partly atypical material, has the upper leaves soft-pilose or tomentulose beneath and the phyllaries with varying amounts of pubescence on the back; while Cronquist, raising it to specific rank as *A. pubentior* Cronq. in Bull. Torr. Bot. Cl. cxxiv. 147 (1947), adds that its "heads are mostly 12–22-flowered, with 4–7 rays and 8–15 disk flowers, instead of 23–54-flowered, with 7–14 rays and 16–40 disk flowers" and also that, "Although there is some slight failure in the distinction", *A. pubentior* is a good species. In view, however, of the occurrence in otherwise perfectly good var. *pubens* of 33 flowers in a head (Clear Lake, Riding Mountain National Park, Manitoba, *Edith Scamman*, no. 2962), of 27 flowers in a head of plants with closely pubescent lower leaf-surfaces and pubescent phyllaries from the North Shore of Lake Superior (Schreiber, Thunder Bay Distr., Ontario, *Hosie, Losee and Bannan*, no. 348), of plants with all the characters of var. *pubens* but with 15 rays or ligules (north of Detroit Lakes, Becker County, Minnesota, *Philip Johnson*, no. 449), of several northwestern specimens with

leaves of *A. pubentior* but with glabrous-backed phyllaries, and of extreme eastern plants with glabrous leaves and backs of phyllaries but with fewer than 23 flowers—in view of this situation I am satisfied that Asa Gray was right in his disposition of the more extreme northwestern plant.

6. Transfers and Minor Variations

Isoëtes melanopoda J. Gay & Dur., forma **pallida** (Engelm.), stat. nov. Var. *pallida* Engelm. in Trans. St. Louis Acad. Sci. iv. 387 (1882).

Botrychium simplex E. Hitchc., forma **laxifolium** (R. T. Clausen), stat. nov. Var. *laxifolium* R. T. Clausen in Bull. Torr. Bot. Cl. lxiv. 277, pl. 7 (1937).

Osmunda regalis L., var. spectabilis (Willd.) Gray, forma **nana,** f. nov., frondibus 1.5–3.5 dm. altis; pinnulis majoribus ellipticis vel oblongo-ovalibus 1.5–3 cm. longis, 0.8–1.1 cm. latis; panicula 5–10 cm. longa.—Alpine or bleak habitats of Newfoundland, Quebec and mountains of northern New England. Type from Newfoundland: serpentine and magnesian limestone barrens, northeastern base and slopes of Blomidon ("Blow-me-down") Mountains, Bay of Islands, August 2, 1910, *Fernald & Wiegand*, no. 2341 in Herb. Gray.

This very dwarf extreme is anything but regal or showy. It is the regular extreme on many mountains and in the type the fertile fronds reach a height of only 2 dm.

Acer rubrum L., forma **pallidiflorum** (K. Koch), stat. nov. Var. *pallidiflorum* K. Koch ex Pax in Engler, Bot. Jahrb. vii. 182 (1886).

Pyrola asarifolia Michx., var. **purpurea** (Bunge), comb. nov. *P. rotundifolia* L., β. *purpurea* Bunge in Mém. Sav. Étrang. ii. 542—repr. 20 (1835). *P. rotundifolia*, β. *incarnata* DC. Prodr. vii. 773 (1839). *P. asarifolia* Michx., var. *incarnata* (DC.) Fern. in Rhodora, vi. 178 (1904).

I am indebted to Dr. Hiroshi Hara for calling my attention to the earlier varietal name and to his generous suggestion that I publish the combination. Bunge's *P. rotundifolia*, β. *purpurea* was from the Altai region, DeCandolle's var. *incarnata* from Dahuria. It extends from north-central and eastern Asia into North America, crossing the continent northward and in our Northeast it too often passes into *P. asarifolia*.

Vaccinium angustifolium Ait., var. **hypolasium,** nom. nov. *V. pensilvanicum* var. *myrtilloides* sensu Fernald in Rhodora, x. 148 (1908) and *V. angustifolium* var. *myrtilloides* sensu House in Bull. N. Y. State Mus. 243–244: 61 (1923), not *V. myrtilloides* Michx., basonym, which proves to be identical with *V. canadense* Kalm.

V. myrtilloides Michx., forma **chiococcum** (Deane), comb. nov. *V. canadense*, forma *chiococcum* Deane in Rhodora, iii. 266 (1901).

V. corymbosum L., var. **albiflorum** (Hook.), stat. nov. *V. albiflorum* Hook. in Curt. Bot. Mag. lxii. (n. ser. ix.), t. 3428 (1835). × *V. corymbosum*, forma *albiflorum* (Hook.) Camp in Am. Midl. Nat. xxiii. 177 (1940).

Liatris graminifolia (Walt.) Willd., var. **virgata** (Nutt.), stat. nov. *L. virgata* Nutt. in Journ. Acad. Nat. Sci. Phila. vii. 72 (1834).

Dr. Gaiser in Rhodora, xlviii. 250 (1946) places Nuttall's *Liatris virgata* in the synonymy of *L. graminifolia*, var. *dubia* (Barton) Gray, which Mr. Haskell Venard has shown is antedated by an earlier varietal name and becomes *L. graminifolia*, var. *racemosa* (DC.) Venard in Rhodora, li. 35 (1949). It seems to me, however, that var. *virgata* is a well marked variety. Barton's *L. dubia*, basis of var. *dubia*, has spiciform racemes; and DeCandolle, under his *L. spicata*, var. *racemosa* (cited by Gaiser as identical with *L. dubia* but on DeCandolle's p. 131, instead of 130) cited plates in the Botanical Register and Loddiges' Botanical Cabinet which are very similar to the Barton plate. Nuttall's *L. virgata* was "Remarkable for the decomposition of its raceme and the long leafy pedicels." Nuttall's type shows the long racemose branches of the panicle nearly 2 dm. long. Other plants from the Southeast (South Carolina, Virginia and the Pine Barrens of New Jersey) are similar, sometimes with the panicled branches nearer 3 dm. long.

L. borealis Nutt., forma **albiflora** (Shinners), comb. nov. *L. novae-angliae* (Lunell) Shinners, f. *albiflora* Shinners in Am. Midl. Nat. xxix. 29 (1943).

L. aspera Michx., forma **Benkii** (Macbr.), comb. nov. *L. scariosa*, f. *Benkii* Macbr. in Field Mus. Pub. Bot. iv. 127 (1927).

PLATES

Photo. B. G. Schubert

BREWERIA AQUATICA: FIG. 1, TYPE of CONVOLVULUS AQUATICUS Walt., × ½; FIG. 2, TYPE of *Convolvulus patens* Desr., × ½; FIG. 3, calyx and style, × 5, from southwest of Hinesville, Liberty Co., Georgia, *Wiegand & Manning*, no. 2632.

Photo. B. G. Schubert

BREWERIA HUMISTRATA: FIG. 1, portion of flowering branch, × 1, from Pee Dee near Mars Bluff Bridge, Florence County, South Carolina, *Wiegand & Manning*, no. 2635; FIG. 2, calyx and style, × 5, from east of Cahoon Pond, northwest of Suffolk, Virginia, *Fernald & Long*, no. 13,429.

Photo. B. G. Schubert

BREWERIA MICHAUXII: FIG. 1, TYPE, also TYPE of CONVOLVULUS TRICHOSANTHES Michx., × ½, after *Cintract;* FIG. 2, portion of flowering branch, × 1, of "*B. aquatica*" of most auth. from Miami, Florida, *Curtiss*, no. 5855; FIG. 3, calyx and style, × 5, from Punta Rassa, Florida, *Tracy*, no. 7719; FIG. 4, portion of flower, × 5, to show long style-branches, from Miami, Florida, *Curtiss*, no. 5855.

Photo. B. G. Schubert

BREWERIA ANGUSTIFOLIA: FIG. 1, portion of plant, ×1, from Dixon, Onslow County, North Carolina, *L. F. & Fannie R. Randolph*, no. 962; FIG. 2, calyx and summits of style, × 5, from near McClellanville, Charleston County, South Carolina, *Godfrey & Tryon*, no. 176, as *B. patens;* FIG. 3, fruiting calyx, × 5, from no. 962.

Photo. B. G. Schubert

BREWERIA PICKERINGII: FIG. 1, TYPE, × 1; FIG. 2, an inflorescence, × 5, showing subsessile central flower and 2-cleft style.

Photo. B. G. Schubert

BREWERIA PICKERINGII, var. CAESARIENSIS: FIG. 1, portion of the Pickering plant from New Jersey, × 1, source of the name but not the description of the Curtis plant from Wilmington, North Carolina; FIG. 2, Pickering's label, × 2; FIG. 3, calyx and style, × 5, from the Pickering plant.

Photo. B. G. Schubert

BREWERIA PICKERINGII, var. CAESARIENSIS: FIG. 1, portion of TYPE, × 1; FIG. 2, branch showing fuller inflorescences, × 1, from Pleasant Mills, New Jersey, July 27, 1882, *H. R. Bassler;* FIG. 3, fruiting calyx and style, × 5, from New Jersey, *Knieskern.*

Photo. B. G. Schubert

BREWERIA PICKERINGII, var. CUTHBERTII, all figs. from TYPE: FIG. 1, TYPE, × ½; FIG. 2, an inflorescence, × 1⅖; FIG. 3, calyx, × 5.

Photo. B. G. Schubert

BREWERIA PICKERINGII, var. PATTERSONI: FIG. 1, portion of TYPE, × 1; FIGS. 2 and 3, calyces and styles, × 5, from TYPE; FIG. 4, calyx and notched style, × 5, from Grant Co., Oklahoma, *Waterfall*, no. 7370; FIG. 5, calyx and entire style, × 5, from Weatherford, Texas, *Tracy*, no. 8068.

Photo. B. G. Schubert

RUBUS ALLEGHENIENSIS, forma SUFFULTUS: FIG. 1, portion of fruiting branch, × ½, from TYPE-SERIES.

R. ALLEGHENIENSIS, var. POPULIFOLIUS: FIG. 2, portion of fruiting branch, × ½, from TYPE-SERIES.

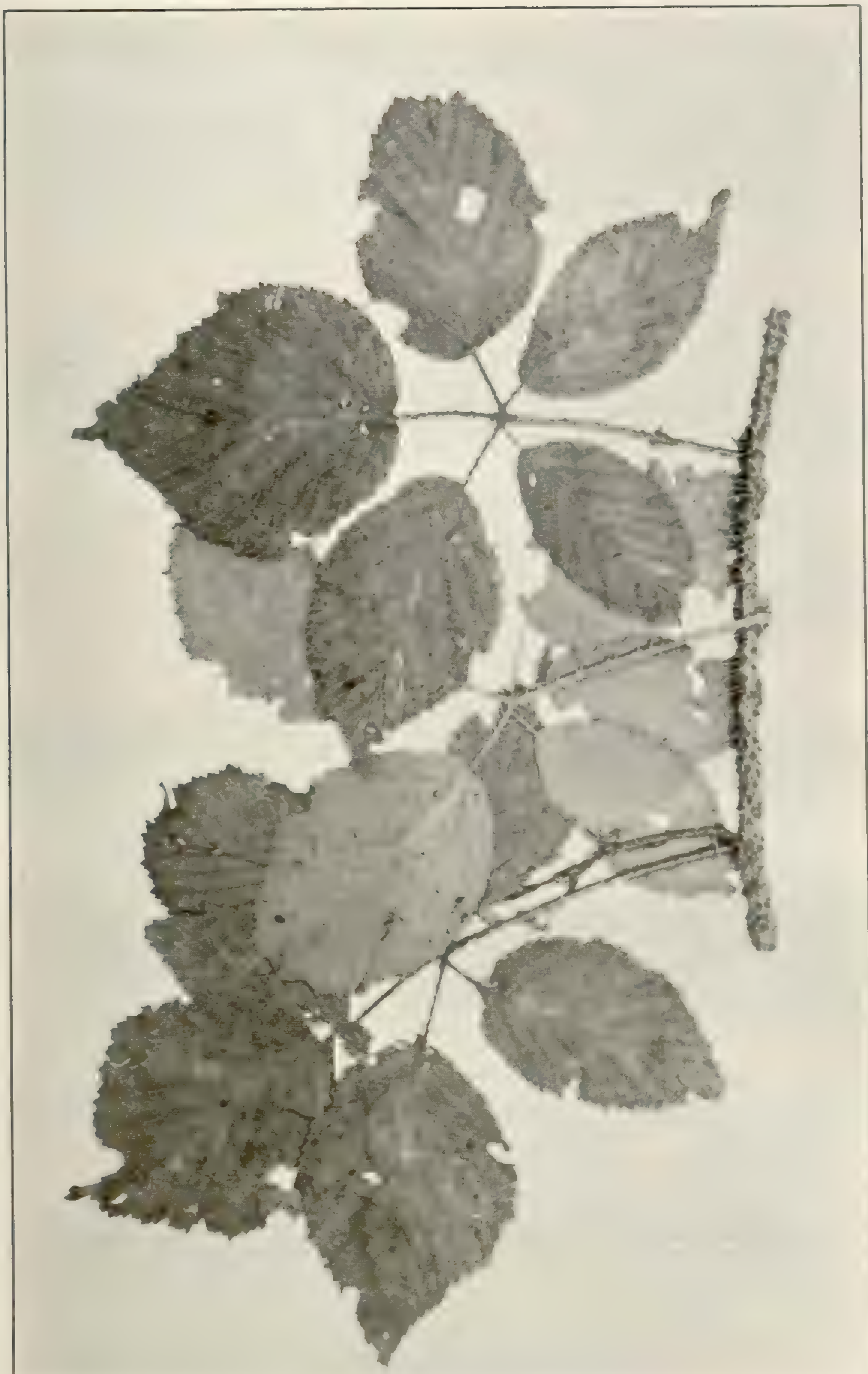
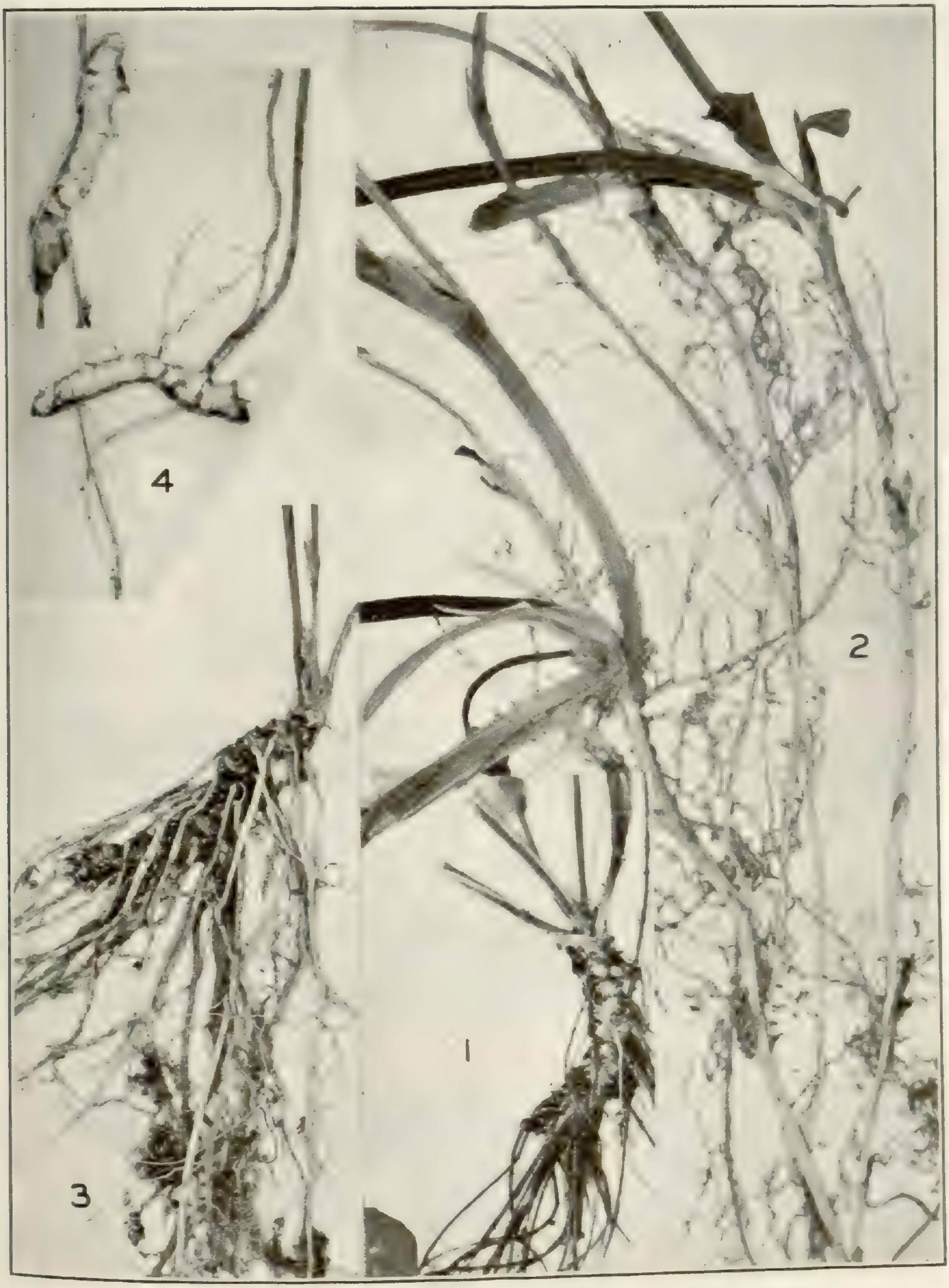


Photo. B. G. Schubert

RUBUS SCELERATUS: small portion of branchlet of primocane, × 2/5, from TYPE-SERIES.

Photo. B. G. Schubert

RUBUS SCELERATUS: small portion of branchlet of floricane, × 2/5, from TYPE-SERIES.



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RHIZOMES OF VIOLA, × 1: FIG. 1, V. CANADENSIS; FIG. 2, V. RUGULOSA; FIG. 3, V. TRIPARTITA, forma GLABERRIMA; FIG. 4, V. HASTATA.

Photo. B. G. Schubert

RHIZOMES OF VIOLA, × 1: FIG. 1, V. LANCEOLATA; FIG. 2, V. LANCEOLATA, var. VITTATA (*V. vittata*).

Photo. B. G. Schubert

RHIZOMES OF VIOLA PRIMULIFOLIA, × 1: FIG. 1, var. ACUTA from Nova Scotia; FIGS. 2 and 3, typical plant from Georgia (isotype of *V. reptabunda* Greene).

Photo. B. G. Schubert

TYPES IN VIOLA, all figs. × 1: FIGS. 1 and 2, V. PEDATA, var. LINEARILOBA, forma RANUNCULIFOLIA; FIG. 3, forma CUNEATILOBA; FIG. 4, V. FIMBRIATULA, forma UMBELLIFLORA.

Photo. B. G. Schubert

OENOTHERA BIENNIS: FIG. 1, portion of plant naturalized in northwestern Europe, × 1, from Buchenau; FIG. 2, calyx, × 1, from Magdalen Islands, Quebec; FIG. 3, calyx, × 3, from Massachusetts; FIG. 4, expanded flower, × 1, from Massachusetts; FIG. 5, flower, × 1, from Minnesota; FIG. 6, seeds, × 5, from New Hampshire.

O. BIENNIS, var. NUTANS: FIG. 7, calyx, × 3, from Virginia; FIG. 8, expanded flower, × 1, from Virginia; FIG. 9, expanded flower, × 1, from New York; FIG. 10, seeds, × 5, from Maryland.

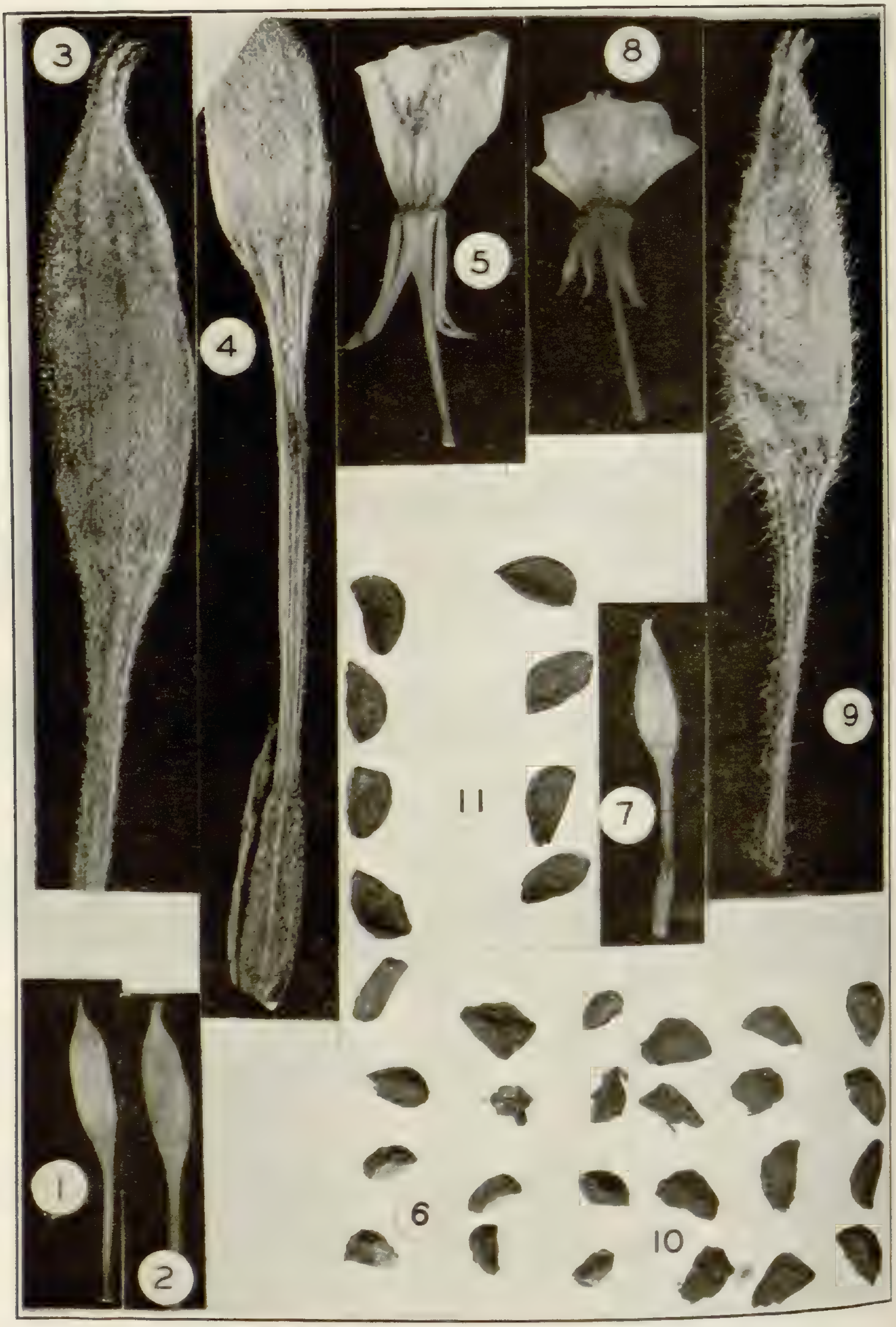

Photo. B. G. Schubert

OENOTHERA BIENNIS, var. CANESCENS: FIG. 1, calyx, × 1, from Saskatchewan; FIG. 2, calyx, × 1, from isotype of *O. canovirens* Steele; FIG. 3, calyx, × 3, from same plant as fig. 2; FIG. 4, ovary and portion of calyx, × 3, from Iowa; FIG. 5, expanded flower, × 1, from Saskatchewan; FIG. 6, seeds, × 5, from Iowa.

O. BIENNIS, var. HIRSUTISSIMA: FIG. 7, calyx, × 1, from Wyoming; FIG. 8, expanded flower, × 1, from Idaho; FIG. 9, calyx, × 3, from Wyoming; FIG. 10, seeds, × 5, from Vancouver Island.

O. ARGILLICOLA: FIG. 11, seeds, × 5, from West Virginia.

Photo. B. G. Schubert

OENOTHERA PARVIFLORA: FIG. 1, calyx, × 1, from Quebec; FIG. 2, expanded flower, × 1, from Quebec; FIG. 3, seeds, × 5, from Prince Edward Island.

O. PARVIFLORA, var. ANGUSTISSIMA: FIG. 4, summit of plant, × 1, from New York; FIG. 5, calyx, × 1, from same plant as fig. 4; FIG. 6, same calyx, × 3.

O. PARVIFLORA, var. OAKESIANA: FIG. 7, seeds, × 5, from Massachusetts.

O. CRUCIATA: FIG. 8, portion of TYPE, × ca. ½.

Photo. B. G. Schubert

OENOTHERA PARVIFLORA, var. OAKESIANA: FIG. 1, summit of TYPE of O. OAKESIANA Robbins, × 1; FIG. 2, bud, × 1, from topotype of *O. Tidestromi;* FIG. 3, ovary and portion of calyx, × 3, from same plant as fig. 2.

Photo. B. G. Schubert

OENOTHERA CRUCIATA: FIG. 1, summit of plant, × 1, from New Hampshire; FIG. 2, calyx, × 1, from Maine; FIG. 3, same calyx, × 3; FIG. 4, expanded flower, × 1, from same plant as figs. 2 and 3; FIG. 5, capsule, × 1, from New York; FIG. 6, same capsule, × 3; FIG. 7, seeds, × 5, from New Hampshire.

Photo. B. G. Schubert

OENOTHERA CRUCIATA, var. SABULONENSIS, all figs. from TYPE: FIG. 1, upper half of plant, × 1; FIG. 2, bud, × 1; FIG. 3, same bud, × 3.

Photo. B. G. Schubert

OENOTHERA CRUCIATA, var. STENOPETALA: FIG. 1, isotype, × 1, of *O. stenopetala* Bicknell; FIG. 2, calyx, × 1, FIG. 3, calyx, × 3, and FIG 4, expanded flower, × 1, all from type-region, Nantucket Island, Massachusetts.

Photo. B. G. Schubert

POLEMONIUM LONGII, all figs. from TYPE: FIGS. 1 and 2, portions of inflorescence, × ca. 1; FIG. 3, cauline leaf, × ca. 1; FIG. 4, flowers, × 3; FIG. 5, calyces, × 3.

Photo. B. G. Schubert

POLEMONIUM REPTANS: FIG. 1, inflorescence and upper leaves, × 1, from western New York.

P. VAN-BRUNTIAE: FIGS. 2 and 3, inflorescence and cauline leaves, × 1, from eastern New York.

Photo. B. G. Schubert

SOLIDAGO PURSHII: FIG. 1, TYPE of *S. humilis* Pursh, basis of *S. Purshii*, with annotation by Asa Gray, × ca. ½; FIG. 2, recent specimen, × 1, from TYPE-REGION; FIG. 3, portion of inflorescence, × 3, from latter plant.

Photo. B. G. Schubert

ASTER CRENIFOLIUS, all figs. from TYPE: FIGS. 1 and 2, summits of plant, × 1; FIG. 3, lower surface of leaf, × 5.

Photo. B. G. Schubert

ASTER FOLIACEUS, summits of plants, × 1: FIG. 1 from TYPE-LOCALITY, Unalaska; FIG. 2 from Newfoundland, this plant identified by Cronquist as *A. crenifolius* (see plate 1147).

Photo. B. G. Schubert

ASTER FOLIACEUS, summits of plants, × 1: FIG. 1 from Alaska; FIG. 2 from Matane Co., Quebec, this plant identified by Cronquist as *A. crenifolius* (see plate 1147).

Photo. B. G. Schubert

ASTER FOLIACEUS: FIG. 1, summit of plant, × 1, from Alaska; FIG. 2, lower surface of leaf of same plant, × 5; FIG. 3, summit of plant, × 1, from Straits of Belle Isle, southeastern Labrador Peninsula, this plant identified by Cronquist as *A. crenifolius* (see plate 1147); FIG. 4, lower surface of leaf of plant shown in FIG. 3.

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CLXX

THE AMERICAN BARBISTYLED SPECIES OF TEPHROSIA (LEGUMINOSAE)

By

Carroll E. Wood, Jr.

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THE AMERICAN BARBISTYLED SPECIES OF TEPHROSIA (LEGUMINOSAE)

CARROLL E. WOOD, JR.

(Plates 1152–1155)

INTRODUCTION

ALTHOUGH the name *Tephrosia* has been used for a genus of moths, it is perhaps more familiar to biologists for a large genus of several hundred species of plants, members of the Tribe Galegeae, Family Leguminosae, widely distributed in warm-temperate and tropical regions. Many of these species produce rotenone and related compounds, so that the group is not only of economic importance as a potential source of insecticides non-poisonous to mammals, but also of ethnological interest in connection with the capture of fish by poisoning. Nevertheless, since the time of DeCandolle no attempt has been made to consider the genus as a whole and even regional monographs have been few and, for the most part, inadequate. To those who have attempted to determine specimens on the basis of existing treatments the need for a revision of the genus should be evident. The high percentage of misidentified specimens in herbaria and the confusion in anthropological, entomological and chemical literature in connection with the use of various species of *Tephrosia* as fish-poisons and insecticides are further indications of the desirability of re-examination of the genus. The large number of species involved, however, and the lack of workable, well-established subgeneric divisions necessitates a piecemeal approach on a regional basis.

Although it was originally intended to attempt a taxonomic revision including all of the North American species, the problem was later recast to deal with only a part of the species of both American continents. This change in emphasis resulted when it became evident that the New World species of *Tephrosia* fall into two rather natural groups: those with glabrous styles and those with bearded or barbate styles. The species with glabrous styles make up a particularly vexing assemblage which it has been impossible to revise in a consistent manner with the information now available. The other group, however, is more amenable to revision, contains a wide range of morphological types and offers a more suitable point for attacking the genus. This paper is limited, therefore, primarily to a survey of the larger, barbistyled group which in the New World occurs principally in North America, with two representatives extending into South America. Various references are made, however, to species with glabrous styles, while much of the general discussion applies to all of the American species; and a list of the names excluded by this style-character is placed at the end of the revision.[1]

Some ninety described species and varieties and many more nomenclatural combinations are involved in the barbistyled group, but a high mortality of binomials in this work leaves the New World with 45 endemic species (including 7 previously undescribed), 2 naturalized exotics and 2 apparent waifs. I do not think, however, that this is needless "lumping," but that specific boundaries are, as a result, more natural and distinct, with the species themselves established on more stable bases than in the past, even though there remain many points of doubt and much to be done, while the interrelationships of most species are anything but clear.

Although almost everyone will agree that in any taxonomic study of a group of plants it is desirable to use information derived from all aspects of the plants and their biology, with some groups certain lanes of approach are, of necessity, either closed or limited until other obstacles are cleared away. It is obvious that it is first necessary to work out a system of interrelationships based on the accumulated information in herbaria with such

[1] For clarity all species belonging to the glabrous-styled group will be marked by an asterisk (*) wherever mentioned in connection with barbistyled species.

geographical and ecological data as may be available. With this as a beginning, further enlightenment may be sought with the aid of more extensive field-study of populations and their ecology, along with anatomical, cytological, genetic and physiological studies. With the additional information thus painfully obtained, the original taxonomic treatment may be remodeled into a more natural one. It is essential first, however, to have some rough outline from which to work.

The revision of the New World barbistyled Tephrosias attempted here is in the nature of that rough outline with a few beginnings of more detailed studies. The approach has been primarily morphological and geographical, with herbarium-specimens as a basis. I have, however, taken the welcome opportunity of escaping from the herbarium to study in the field a number of the species of the United States and Mexico, so that my acquaintance with the genus is not entirely second-hand. A beginning has also been made in the use of cytological data and some anatomical information has been obtained. Unfortunately, the inaccessibility of the regions in which many of the plants grow, the impossibility of obtaining seeds of more than half of the species, the relatively slow growth, deep tap-roots and perennial habit and, particularly, the difficulties of cultivation of most species in the northern part of the United States have precluded environmental manipulations and genetic experiments. In addition, a number of the species from the poorly explored mountains of western Mexico are represented by only one or a few collections, mostly with scanty field-data, so that the distribution, range of variation, flower-color, fruit and seeds are poorly understood or completely unknown. This beginning is presented, however, without apologies, but with the usual hope that it will indicate some of the problems involved and lead to further, more complete, studies of the genus.

Acknowledgments

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Particular acknowledgment is due for the assistance given me by Harvard University through an Atkins Scholarship in 1947 and a Parker Fellowship in Biology in 1948–49. The first enabled me in the summer of 1947 to undertake field-studies with Dr. and Mrs. I. D. Clement on the southeastern Coastal Plain and then in Cuba, where a month was spent at the Atkins Garden and Research Laboratory of Harvard University at Soledad, near Cienfuegos. I am indebted to Dr. A. G. Kevorkian, then Director, for many favors during the stay at Soledad. As a Parker Fellow in 1948, I was able to spend two months in field-study in Mexico with Dr. H. E. Moore, Jr., now of the Bailey Hortorium, Cornell University. Data and seeds from numerous species of *Tephrosia* studied in the western Sierra Madre have resulted in the clarification of a number of problems.

The curators of the following institutions (designated in the

text by the initials here given[1]) have generously permitted me to borrow extensively from the abundant material in their care:

A	Arnold Arboretum, Harvard University
CAS	California Academy of Sciences
DS	Dudley Herbarium, Stanford University
DUKE	Duke University
F	Chicago Natural History Museum
FLAS	Agricultural Experiment Station, University of Florida
GA	University of Georgia
GH	Gray Herbarium, Harvard University
ISC	Iowa State College
K	Royal Botanic Gardens, Kew
KSA	Kansas State Agricultural College
KY	University of Kentucky
MEXU	Instituto de Biologia, Universidad Nacional de México
MIAMI	Buswell Herbarium, University of Miami, Coral Gables
MO	Missouri Botanical Garden
NEBC	New England Botanical Club
NY	New York Botanical Garden
OKL	University of Oklahoma
PH	Academy of Natural Sciences of Philadelphia
PHBC	Philadelphia Botanical Club
POM	Pomona College
SMU	Southern Methodist University
TENN	University of Tennessee
TEX	University of Texas
UC	University of California (including the Clokey Herbarium)
US	United States National Herbarium
WVA	West Virginia University

Historical Account

The confused history of *Tephrosia* as a genus began with Linnaeus who, in the first edition of *Species Plantarum* (1753), set off the genus *Cracca* with six species, all of which are currently recognized as species of *Tephrosia*. Later, however, he doubted the distinctness of *Cracca* and merged it with *Galega* (Linnaeus 1759, p. 1172),[2] where it remained in obscurity until resurrected by Kuntze in 1891.

After Linnaeus numerous species were described under *Galega* (which became more or less a catch-all) and at least four other generic names were applied to plants now included in *Tephrosia*. The genus *Tephrosia* itself was proposed as segregate from *Galega* by Persoon (1807, pp. 328–330) who transferred into it a rather heterogeneous series of species, including the original *Craccae* of Linnaeus (and related species) as well as plants now

[1] Most of the abbreviations adopted are those suggested by Lanjouw (1939, 1941).

[2] In a footnote he explains, "Galegam *770* & Craccam *795 genere sub eodem comprehendi docuere recentiores observationes*".

recognized as belonging to very different genera. Although *Tephrosia* Pers. was thus a superfluous name (including as it did *Cracca* L.), it was adopted by most writers and the extraneous elements gradually removed to other genera, leaving the genus taxonomically essentially as now understood and nomenclaturally synonymous with *Cracca* L.

Some of the last of the discordant elements included in *Tephrosia* by Persoon were removed by Bentham (1854) who erected for them an entirely new genus *Cracca*[1], based on *Galega caribaea* Jacq., a plant morphologically quite different from true *Tephrosia* Pers. (*Cracca* L.). The situation was still further complicated by the appearance of a third genus *Cracca* when Alefeld (1861), agreeing with Grenier and Godron (1848), revived the pre-Linnaean *Cracca* Riv. (1691)[2] for a portion of *Vicia* L. Adopting the view that this earlier use of the name necessitated new names for both *Cracca* L. and *Cracca* Benth., Alefeld (1862) continued the use of *Tephrosia* Pers. for the former and proposed a new name, *Benthamantha*, for the latter. Most authors, however, either overlooked or ignored Alefeld and continued to use *Tephrosia* Pers., *Cracca* Benth. and *Vicia* L. (*sens. lat.*). Finally, to make the confusion complete, Kuntze (1891), on the basis of priority, adopted *Cracca* L. for *Tephrosia* Pers., transferred all the known species of *Tephrosia* to that genus and, apparently not knowing of Alefeld's *Benthamantha*, proposed yet another name, *Brittonamra*, for *Cracca* Benth.

Cracca [Riv.] Medic. has not seriously been considered as a genus since Alefeld, but *Cracca* L. and the very different *Cracca* Benth. have inevitably been badly tangled nomenclaturally. Although *Tephrosia* Pers., which had been widely used for almost a hundred years, was conserved over both *Cracca* L. and *Cracca* Medic. by the International Botanical Congress of 1905 and was again included in the list of *nomina conservanda* in 1910, adherents to the American Code continued to recognize *Cracca* L. as the proper name for the genus. *Cracca* Benth.,

[1] Although the name is usually cited as of Benth. ex Oerst., both Bentham and Oersted are the authors of this paper. The proper citation is *Cracca* Benth. ex Benth. & Oerst.

[2] Although these authors attributed the genus to Rivinius, under the present rules this is properly *Cracca* Medic. Vorles. Churpf. Phys. Ges. 2: 359. 1787, which was proposed as a segregate from *Vicia* L., based on *V. Gerhardi* Jacq., *V. benghalensis* L. and a new species, *C. syriaca*. It is treated by most authors as a section of *Vicia* L. or as a synonym under that genus.

twice a later homonym, became *Benthamantha* Alef. However, with the demise of the American Code the conservation of *Tephrosia* was again confirmed (Briquet 1935) and has been generally accepted.

Cracca Benth. has now been proposed and accepted for conservation (Rehder et al. 1935; Sprague 1940), but has not yet been acted upon by a Botanical Congress. The proposed conservation of this name which, although rather generally accepted until fifty years ago, has since become surrounded by an aura of confusion, at least in the United States, would not seem to contribute to nomenclatural clarity. It would appear better to eliminate the name completely and to continue to use *Benthamantha* Alef. There could then be no doubt as to which genus was intended. It is to be hoped, however, that, should *Cracca* Benth. be approved as a conserved name by the next International Botanical Congress, the confusion will abate in time.

The nomenclatural confusion aside, *Tephrosia*, as a genus, has been the subject of relatively few treatments. No attempt has been made since A. P. DeCandolle (1825, pp. 248–256) to monograph the genus on a world-wide scale, although several regional works have treated it in part. E. G. Baker (1926) revised the species of tropical Africa, recognizing 146 species, many of which were based on variable pubescence-characters. According to an excellent recent monograph (Forbes 1948), 67 species are known from South Africa. The most recent monograph of the Australian species is that of Domin (1926, pp. 746–756) who concluded that 23 species occur in that continent. The Asiatic species have not yet, to my knowledge, been treated as a group.

Although numerous short papers concerned with North American Tephrosias have been published, only four have dealt with these at any length. The first was a "Revision of the North American Species of *Cracca*" by Anna Murray Vail (1895). She concluded that 14 species and 3 varieties occurred in "North America" (i. e., the United States). Four years later B. L. Robinson (1899), dissatisfied with Miss Vail's work, published a somewhat more useful "Revision of the North American Species of *Tephrosia*," still restricting North America to the United States and including 12 species and 5 varieties. A further treat-

ment of importance was not forthcoming until Standley (1922) brought together in his "Trees and Shrubs of Mexico" much of the available information concerning 26 Mexican species.

It remained, however, for Rydberg (1923) to monograph the species occurring in North America, including the West Indies. This work, in which he treated 72 species, 16 of which were described as new, is far from satisfactory, for many of the specific descriptions are little more than rewordings of the original, usually inadequate diagnoses, the keys contradict both themselves and the descriptions, and the specific lines are often finely drawn and based entirely on such inconstant characters as pubescence of the vegetative organs. Rydberg's herbarium annotations follow the outlines of his monograph and indicate that he did not clearly understand many of the entities with which he was dealing. However, handicapped though he was by the relatively few specimens then available and by his extreme tendency toward "splitting", his work remains to date the only outline of the North American species. About 50 of the 72 species given by Rydberg appear to represent "good" species.

Various notes concerning South American species have been published, but apparently nothing dealing expressly with these as a group has appeared. Bentham in Martius, Fl. Bras. **15** (1): 46–50. 1859, recognized 7 species in Brazil. Comments on the genus in Brazilian Amazonia are included in Ducke's work (1939) on the legumes of that region and Burkart (1943) records 3 species from Argentina in his study of the legumes of that country. A number of species were dismembered by Chodat and/or Hassler in various publications.

Economic Importance

Various species of *Tephrosia* have been used as fish-poisons in the Americas, Africa, Asia and Australia. It is remarkable that primitive peoples in such isolated parts of the world, lacking any apparent communication with one another, have discovered and domesticated species of the same genus for the same purpose, the poisoning of fish. The species most frequently mentioned in this connection are *Tephrosia Sinapou* in the Caribbean area and South America, *T. multifolia* and *T. Sinapou* in Central America,

T. Vogelii and *T. macropoda* in Africa, and **T. rosea* and **T. astragaloides* in Australia.

An early account of fish-poisoning with *Tephrosia Sinapou* in Jamaica illustrates the general method used in capturing fish:

> The leaves and branches of this plant, being well pounded and thrown into any river, pond, or creek, are observed to infect the waters very soon: by which all the fish are immediately intoxicated and rise and float upon the surface, as if they were dead; from whence they are easily taken. But most of the large ones that are left recover from this trance, after a short time: tho' the greatest part of the small fry perish on those occasions (Browne 1756, p. 296).

Although in this instance the shoots are toxic to fish, in other species only the roots are used, the foliage being completely harmless. *Tephrosia Sinapou* appears to have been widely cultivated in the Caribbean region in pre-Columbian times and even later. Browne (1756) notes that it was "introduced to *Jamaica* from the main", and was "cultivated in many parts of the island, on account of its intoxicating qualities". With the near extinction of the Indians of the Caribbean, however, the plant has become rare in the West Indies, although it is still widely cultivated in South America as a fish-poison.

Some species have long been used by primitive peoples as insecticides, as well as fish-poisons, and in recent years have come to the attention of economic entomologists and chemists. The toxic qualities of these plants are due to the presence of rotenone, deguelin and related compounds which are chemically identical with those found in *Derris* and *Lonchocarpus*, the commercial sources of rotenone. They are not, however, present in such large quantities as in those plants, and this factor limits the commercial exploitation of *Tephrosia* species at the present time. The maximum rotenone- and deguelin-content of *Tephrosia virginiana*, for example, is about 4 per cent, whereas Derris and *Cube* often contain 10 per cent or more (Roark 1937).

Nevertheless, rotenone has become so important as an insecticide non-poisonous to mammals that extensive surveys have been conducted by the U. S. Department of Agriculture to determine the feasibility of cultivating native species as commercial sources. In 1934 and 1935, many of the species of the southeastern United States were tested, but only *Tephrosia virginiana* (including *T. latidens*) appeared to be promising (Sievers, Russell et al.

1938). As a result, cultural experiments in the United States have been confined to this species.

In the course of one of these surveys (1935), plants of *Tephrosia virginiana* from many localities from Virginia southward and westward were tested for the presence of rotenone. Large areas were found to lack completely any toxic plants, but plants with relatively high rotenone content were found in light, sandy soils in northeastern and western Florida, and in northeastern Texas within a narrow belt extending some 300 miles between Caldwell and Harrison counties. Secondary districts were located in Georgia, Louisiana, Texas and Oklahoma. The evidence accumulated at that time suggested that the presence of toxic substances was controlled by genetic factors, the expression of which was affected by the environment, particularly edaphic conditions (Sievers, Russell et al. 1938). Transplant-experiments have since indicated that the controlling factors are indeed hereditary, for plants with high rotenone-content retain their toxicity when transferred to a region yielding only mediocre material, and also when transferred from one soil-type to another. It has also been shown that highly toxic plants tend to produce offspring of similar toxicity (Little 1942).

Tephrosia virginiana responds well to cultivation in sandy soils, requiring little attention and giving economically promising yields. The roots, in addition to producing rotenone[1], harbor nitrogen-fixing bacteria. The leaves and stems of this species are non-toxic and have some value as hay.

A great mass of technical literature concerning the use of *Tephrosia* as an insecticide has accumulated in the last 20 years. The portion up to 1937 has been thoroughly reviewed by Roark (1937). A more general account up to 1941 of the literature concerning plants of possible insecticidal value has been given by McIndoo (1945).

Tephrosia species have also been utilized in tropical agriculture as green manures, cover-crops, soil-binders and contour-hedges. Most of the species so used are native to the Eastern Hemisphere, although "*Tephrosia toxicaria*" (either *T. Sinapou* or *T. multifolia*) has been grown as a green manure in the Nether-

[1] Rotenone is found concentrated in the xylem and not in the bark. All roots contain the same proportion of toxic substances regardless of size (Sievers, Russell et al. 1938).

lands Indies. **Tephrosia noctiflora* appears to have been introduced into the West Indies as a cover-crop, as perhaps was *T. candida*.

Various medicinal properties have been assigned to *Tephrosia* species. Among these may be mentioned the use of the roots of *T. virginiana* as a vermifuge by the Indians of eastern North America (Griffith 1847; Rafinesque 1830). The purgative properties of **T. Senna* HBK. (*T. cathartica*) are further commemorated by the common name "Wild Senna" in the British West Indies.

The ornamental possibilities of *Tephrosia* have been little explored, although *T. Vogelii* is cultivated in tropical Africa both as a fish-poison and as an ornamental shrub. *Tephrosia macrantha*, a shrub of western Mexico with large, attractive flowers and a long blooming period, would probably make a very desirable cultivated plant in frost-free regions.

Cytology

In addition to the usual morphological characters, an attempt was made to utilize the chromosome-numbers of some of the species of *Tephrosia* as a systematic criterion. More data of this type seemed to be particularly desirable since Senn (1938), in reviewing the chromosomal relationships within the Leguminosae, had indicated that the genus was evidently in need of careful chromosomal, as well as taxonomic, study.

Efforts were made in the summer of 1947 to secure counts of meiotic chromosomes, particularly those of **Tephrosia cinerea*, at the Atkins Garden and Research Laboratory at Soledad, Cuba. These attempts were all unsuccessful, probably because of the sporadic flowering of the inflorescence. The available species of the southeastern United States proved equally difficult. In consequence, chromosome counts from root-tips have been relied upon exclusively.

Mature seeds of seven species of *Tephrosia* were collected in the southeastern states and seeds of **T. cinerea* in Cuba in 1947. In 1948, 3 more species were added from Texas and Mexico. At Soledad fresh, nearly mature but still quite green seeds of **T. cinerea* germinated immediately in moist Petri dishes, producing vigorous root-tips. In addition, seeds taken from herbarium-specimens have, in many instances, germinated readily. Perma-

nent slides were prepared[1] and chromosome-counts obtained for 27 species. The diploid number is 22 in all. (See Table 1 and Plate 1152).[2]

The chromosome-numbers of only two species have been recorded previously. These are "*T. Hookeriana* W. & A." (probably = *T. villosa* (L.) Pers.), n = 16, according to Kawakami (1930) and *T. virginiana* (L.) Pers., n = 11, reported by Senn (1938, p. 231). The occurrence of these two numbers within the genus was pointed out by Senn as remarkable, particularly since 11 was a number unknown elsewhere within the Tribe Galegeae, 8 being the basic number of most genera. Since then, however, 13 species with 11 pairs of chromosomes have been reported in *Astragalus* (Vilkomerson 1943), a genus previously believed to have only 7 and 8 as the basic numbers, so that the occurrence of 8 and 11 in *Tephrosia* would not necessarily be particularly remarkable. The counts of 27 species of *Tephrosia*, all with 22 somatic chromosomes, suggest, moreover, that the genus is probably very uniform in chromosome-number and strongly indicate that the reported haploid number of *T. Hookeriana* is erroneous. Since the species counted represent a wide range of morphological types, including three Old World species (one presumably a close relative of *T. Hookeriana*), it is likely that these results are fairly conclusive, except for the possibility of polyploid species. To

[1] The seed-coats of dry, mature seeds were sterilized by immersion in 70 per cent alcohol for a few minutes and scarified with a scalpel. The seeds were then rinsed in sterile distilled water and placed on moist filter-paper in sterile Petri dishes. Imbibition of water took place rapidly and germination often followed overnight. Root-tips were stained whole by the Feulgen technique following Belling's or Randolph's fixative, embedded in paraffin via ethyl alcohol and chloroform, sectioned at 10 microns, affixed to slides, passed through xylene to remove the paraffin and finally mounted in balsam. Good results are difficult to obtain in this group with any of the various smearing or "squashing" techniques. Drawings of the chromosomes were made with camera lucida, oil-immersion objective (90x) and 20x compens oculars. Counts are documented by specimens in the herbaria indicated in Table 1.

[2] PLATE 1152. Somatic Chromosomes of *Tephrosia* and *Sphinctospermum*. Mitotic figures from root-tips. Figure 4 ca. 2750 ×, all other figures ca. 2600 ×. All documenting specimens in (GH). 1. **Tephrosia vicioides* (Purpus 8171); 2. **T. tenella* (Gentry 4684); 3. **T. noctiflora* (Archer 2557); 4. **T. angustissima* (Wood & Clement 7492); 5. *T. virginiana* (Wood & Clement 7605); 6. *T. Sinapou* (Pringle 11436); 7. *T. Conzattii* (Hinton 6998); 8. *T. foliolosa* (Gentry 5279); 9. *T. nitens* (Hinton 11037); 10. *T. belizensis* (Schultes & Reko 552); 11. *T. spicata* (Wood & Clement 7531); 12. *Sphinctospermum constrictum* (Gentry 4676); 13. *T. hispidula* (Wood & Clement 7194); 14. *T. florida* (Wood & Clement 7596); 15. *T. chrysophylla* (Wood & Clement 7172a); 16. *T. Rugelii* (Wood & Clement 7512); 17. *T. florida* (topotype of *T. gracillima*) (Wood & Clement 7202); 18. *T. chrysophylla*, tetraploid cell (Wood & Clement 7525a); 19. *T. Rugelii*, tetraploid cell (Wood & Clement 7512).

TABLE 1
Chromosome-Numbers of *Tephrosia*, *Cracca* and *Sphinctospermum*

Species	2n	Collection	Year	Locality
T. multifolia	22	Rose, Standley & Russell 14227 (GH)	1910	Nayarit
	22	Calderón 2611 (F)	1933	El Salvador
T. foliolosa	22	Gentry 5279 (GH)	1939	Durango
T. Sinapou	22	Pringle 11436 (GH)	1903	Jalisco
T. leiocarpa	22	Gentry 4894 (GH)	1939	Sonora
T. Conzattii	22	Hinton 6998 (GH)	1934	México (State)
	22+2f			
T. virginiana	22	Wood & Clement 7605 (GH)	1947	South Carolina
	22	7613 (GH)	1947	North Carolina
T. onobrychoides	22	Moore & Wood 3616 (GH)	1948	Texas
T. rhodantha	22	Hinton 11641 (GH)	1937	Guerrero
T. cana	22	Carter, Alexander & Kellogg 2406 (UC)	1947	Baja California
	22	Gentry 4366 (DS)	1939	Baja California
T. Palmeri	22	Gentry 3718 (MO)	1938	Baja California
T. Rugelii	22	Wood & Clement 7170 (GH)	1947	Florida
		7512 (GH)	1947	Florida
T. spicata	22	Wood & Clement 7178 (GH)	1947	Florida
	22	7531 (GH)	1947	Florida
	22	7608 (GH)	1947	North Carolina
T. hispidula	22	Wood & Clement 7194 (GH)	1947	Florida
	22	7547 (GH)	1947	Florida
T. florida	22	Wood & Clement 7089 (GH)	1947	South Carolina
	22	7202 (GH)	1947	Florida
	22	7527 (GH)	1947	Florida
	22	7532 (GH)	1947	Florida
	22	7560 (GH)	1947	Georgia
	22	7565 (GH)	1947	Georgia
	22	7596 (GH)	1947	South Carolina
	22	7598 (GH)	1947	South Carolina
	22	7607 (GH)	1947	North Carolina
T. chrysophylla	22	Wood & Clement 7172a (GH)	1947	Florida
	22	7525a (GH)	1947	Florida
T. Lindheimeri	22	Moore & Wood 3617 (GH)	1948	Texas
T. potosina	22	Moore & Wood 3618 (GH)	1948	Nuevo León
T. nitens	22	Hinton 11037 (GH)	1937	Guerrero
T. belizensis	22	Schultes & Reko 552 (GH)	1939	Oaxaca
T. grandiflora	22	Orcutt 3235 (UC)	1927	Jamaica
T. Vogelii	22	No voucher; identified from seeds only, but these unmistakable.	1946	Cultivated, Bianchi, Guatemala
**T. cinerea*	22	Wood 7537 (GH)	1947	Cuba
**T. Senna*	22	Rose et al. 3228 (GH)	1913	St. Kitts, British West Indies
**T. tenella*	22	Gentry 4684 (GH)	1939	Sonora
**T. angustissima*	22	Wood & Clement 7492 (GH)	1947	Florida
**T. vicioides*	22	Purpus 8171 (GH)	1918	Veracruz
**T. noctiflora*	22	Archer 2557 (GH)	1934	Cultivated, British Guiana
Cracca sp.	16	Hinton 8740 (GH)	1935	México (State)
Sphinctospermum constrictum	16	Gentry 4676 (GH)	1939	Sonora

* Styles glabrous.

date, no polyploids have been found, although a few tetraploid cells were encountered in the roots of *T. chrysophylla*, *T. florida* and *T. Rugelii* (Pl. 1152, fig. 18, 19). Such polysomatic cells have been found more or less irregularly, both in the roots of a number of leguminous genera (Atchison 1948; Vilkomerson 1943) and in various tissues of other families as well, and may be a normal feature of differentiated tissues (Huskins 1948).

The apparent uniformity of chromosome-number in *Tephrosia*, at least in the Western Hemisphere, is disappointing at the species-level, but is interesting as a generic character. Few of the supposedly related genera have been studied cytologically, but two species of *Galega* have been reported with 8 pairs of chromosomes (Kreuter 1929, 1930; Senn 1938). A single species of *Cracca* and the monotypic *Sphinctospermum* also have 8 pairs, although neither of these genera is particularly closely related to *Tephrosia*. The presence of 8 pairs of chromosomes in *Sphinctospermum* is especially interesting, since this plant was originally described as a *Tephrosia* by Sereno Watson. Rose erected a new genus for it on morphological grounds; the chromosome-numbers strengthen this already strong segregation. In both morphology and chromosomes it is much more closely related to *Cracca* Benth. than to *Tephrosia*.

With the amount and type of material now available it seems unwise to attempt to utilize chromosome-morphology as a comparative character. From a glance at Plate 1, however, it will be evident that the chromosomes of at least some of the glabrous-styled species are noticeably smaller than those of barbistyled species and that satellites are present on two chromosomes. Unfortunately, although the satellites are large, they are seldom visible, even in species in which they have definitely been observed. It may also be noted that absolute chromosome-size varies considerably from one cell to another within the same root-tip. In addition, one possible example of ageing in 15-year-old seeds of *Tephrosia Conzattii* is found in the appearance of 22 chromosomes plus 2 fragments in dividing cells of one seedling root-tip (Plate 1152, fig. 7). A second root-tip had 22 apparently "normal" chromosomes.

Longevity of Seeds

Incidental to securing root-tips for chromosome-counts, a few data concerning the longevity of seeds of *Tephrosia*, *Cracca* and *Sphinctospermum* have accumulated. The results from herbarium-collections are given in Table 2; freshly collected seeds usually give almost 100 per cent germination. While the quantities of seeds employed are too small to be statistically significant, the results are interesting in that they conform to the findings of Becquerel, Ewart, Turner, Schelderup-Ebbe and others that seeds of Leguminosae are relatively resistant to ageing and retain the power of germination for long periods.

It is of interest to note that the seeds used in the present experiments were taken from specimens which, at least in the Gray Herbarium, have been stored for the periods indicated in a very dry, steam-heated building. These have, in addition, been fumigated with carbon bisulfide at least twice. That any seeds at all germinated attests to the impervious nature of the seed coats.

In the fall of 1948, 15 seeds of *Tephrosia potosina* and 5 of *T. onobrychoides* (*Moore & Wood 3618* and *3616*, respectively) were subjected to the heat-treatment newly initiated at the University of California to rid herbarium-specimens of insects. In this process the temperature of an insulated room containing the specimens is raised slightly above 60° C. for about 12 hours and then allowed to return slowly to normal. All insects are destroyed by this treatment, but all 20 of the fresh seeds were apparently unharmed and germinated immediately.

These data from *Tephrosia* hardly compare, however, with records of Becquerel and Ewart of old seeds kept in herbaria or seed-cupboards. Crocker (1938) has summarized their material in reviewing the literature concerning the life-span of seeds. The following are the oldest definitely known records, all from leguminous species except the last:

Cassia bicapsularis L.	115 years old	40%	germination
Cassia multijuga Rich.	158	100%	
Goodia lotifolia Salisb.	105	7.7%	
Hovea linearis R. Br.	105	17%	
Nelumbo nucifera L.	150	85%	

Other records of Becquerel, Ewart, Turner and Schelderup-Ebbe as given by Crocker show several additional legumes re-

TABLE 2

Longevity of Seeds of *Tephrosia*, *Cracca* and *Sphinctospermum*

Species	Collection	Year	Age at test	No. tested	No. germinated	% germination
**Tephrosia tenella*	Hinckley 2959 (GH)	1944	3 yrs.	3	3	100
**T. tenella*	Gentry 4684 (GH)	1939	8	2	2	100
Sphinctospermum constrictum	Gentry 4676 (GH)	1939	8	5	5	100
T. belizensis	Schultes & Reko 552 (GH)	1939	8	4	4	100
T. foliolosa	Gentry 5279 (GH)	1939	8	2	1	50
T. cana	Gentry 4366 (DS)	1939	8	1	1	100
T. leiocarpa	Gentry 4894 (GH)	1939	8	5	4	80
T. Palmeri	Gentry 3718 (MO)	1938	10	2	2	100
T. nitens	Hinton 11037 (GH)	1937	10	2	1	50
T. rhodantha	Hinton 11641 (GH)	1937	10	5	5	100
Cracca sp.	Hinton 8740 (GH)	1935	12	4	3	75
T. Conzattii	Hinton 6998 (GH)	1934	13	5	1	20
**T. noctiflora*	Archer 2557 (GH)	1934	13	5	2	40
T. multifolia	Calderón 2611 (F)	1933	15	6	5	83
T. grandiflora	Orcutt 3235 (UC)	1927	21	6	4	66
T. multifolia	Standley 20463 (GH)	1922	25	10	1	10
**T. vicioides*	Purpus 8171 (GH)	1918	29	13	6	46
**T. Senna*	Rose et al. 3228 (GH)	1913	34	3	2	66
T. multifolia	Rose, Standley & Russell 14227 (GH)	1910	37	9	1	11
T. Sinapou	Pringle 11436 (GH)	1903	44	4	2	50
T. leiocarpa	Pringle 11434 (GH)	1903	44	1	0	0
T. leucantha	Palmer 745 (GH)	1898	49	4	0	0
T. leiocarpa	Palmer 594 (GH)	1886	61	7	0	7
	Palmer 594 (US)	1886	62	8	1	

* Styles glabrous.

taining the power of germination after 80 years. Species with a known life-span of over 50 years include representatives of the Iridaceae, Cannaceae, Tiliaceae, Malvaceae, Euphorbiaceae, Convolvulaceae and Labiatae.

From casual observation the unsuccessful germination of *Tephrosia* seeds appeared in many instances to be due to the failure of the hypocotyl and radicle to grow. The cotyledons often remained firm and alive and in some cases expanded and became green in sunlight.

Morphology and Taxonomic Criteria

As with many genera of Leguminosae, *Tephrosia* is not distinguished by an abundance of readily utilizable taxonomic

characters. Many parts of the plant are so variable or differ so little from one species to another that no taxonomic value can be assigned to them. Although one plant may differ from another in appearance, the problem has been one of establishing such differences on firmly objective bases. To this end as many aspects of the plant as possible have been examined. The criteria which, as a result, have been chosen are, in large part, different from those used by Rydberg and other American authors. A surprising number of characters have been found in the flowers in spite of their apparently uniform papilionaceous structure. Other characters are located in the inflorescence, fruit and some of the vegetative parts, notably the leaves. No single criterion, however, can be employed throughout the genus, so that specific delimitations are usually on the basis of varying sets of characters from one group of species to another. Notes on morphology apply primarily to the species dealt with in this revision, although much of this material will apply as well to the species with glabrous styles.

Habit.—All of the American species are perennial, although **Tephrosia tenella* apparently flowers the first year from seed and may sometimes behave as an annual plant. Both herbaceous and fruticose types are included, but almost all species are somewhat woody at the base, the herbaceous types springing from a woody crown. The erect, decumbent, or prostrate habit may be of diagnostic value, but such information is seldom included on herbarium labels. *Tephrosia chrysophylla,* for example, is always completely prostrate, but in a presumed hybrid of this species with *T. florida* the stems are prostrate while the leaves are usually ascending.

Branching of the herbaceous species is either monopodial or sympodial, but this character does not seem to be of any very fundamental importance. (See *Inflorescence* and RELATIONSHIPS.)

Roots.—A heavy, woody tap-root is present in many species, but is not often collected. In *T. hispidula* this is characteristically carrot-like, in contrast to the cylindrical roots of *T. florida* and *T. spicata,* species with which it is sometimes confused. The roots of *T. virginiana* are many, long, slender, very tough and account for the popular names "cat-gut" and "devil's shoestring".

Leaves.—In all of the American species the leaves are im-

paripinnate with from one to forty-one leaflets, the leaflet-number varying within definite limits in each species. In seedlings the lowermost leaves are few-foliolate, but the leaflets increase in number with each successive leaf until a specific limit is reached. The same is, to a large degree, true of leaves produced by older plants within a season.

Petioles are usually present on at least some of the leaves, but the length of the petiole generally decreases from the lower leaves upward. Length is, therefore, usually of little value as a diagnostic character, although it is important in distinguishing the putative hybrid, *T. chrysophylla* × *T. florida*, from its parents, both of which are extreme types. The rachis and sometimes the petiole are channeled on the upper side.

The *leaflets*, which range from narrowly linear to orbicular, from 0.5 to 18 cm. long, and from membranous to thick and leathery, are important points of recognition, once the range of variability has been determined.

More or less prominent parallel lateral veins are given off obliquely from the midrib of the leaflet in all species. The areoles formed by the veinlets between these veins are, with a few intermediate exceptions, either elongate or nearly isodiametric. This feature might appear to be correlated to some extent with the shape and width of the leaflet, but this is not necessarily so, as is evidenced by several pairs of species with leaflets of approximately the same shape and size but areoles of different shapes. The venation-type, which is usually constant within a species, is summarized in Table 3. With the exception of the few somewhat confusing intermediates, the shape of the areoles is a useful character and is, in general, correlated with the presence or absence of stomata in the upper epidermis. It will also be noted from Table 3 that these types seem to run in series of related species (which, incidentally, were determined on the basis of gross morphology before these features were studied in detail).

The presence or absence of stomata in the upper epidermis appears to be characteristic of many species. It almost goes without saying, however, that such an anatomical feature needs much more careful study with emphasis on the effect of environmental fluctuations before much dependence can be placed on it as a specific character. Nevertheless, in at least some species

this seems definitely to be a constant characteristic. The stomata of most of the species with dull, thin leaves can be seen under a strong dissecting microscope as light flecks in the dried leaflet-tissue. In these species stomata are invariably present in the upper epidermis.

Stomata are completely absent from the upper epidermis of a number of species with more or less coriaceous leaves, although in other species they may be present along the midrib only, while in still others they may be either present or completely absent (Table 3).[1] The presence or absence of stomata supplies a useful supplementary character (although one which will hardly be employed enthusiastically by most taxonomists, including myself) in distinguishing between *Tephrosia Pringlei* and *T. Seemannii* and to lesser extent between *T. Langlassei* and *T. simulans*. Without exception, in all the specimens I have seen, stomata are present in the upper epidermis of *T. Pringlei* but completely absent from that of *T. Seemannii*. This difference is correlated with elongate areoles between the lateral veins of *T. Pringlei* and nearly isodiametric areoles in *T. Seemannii*.

All leaflets are petiolulate and probably exhibit turgor-movements, particularly in connection with changes in light-intensity. Sleep-movements and orientations of the leaflets in sunlight have been observed in **Tephrosia cinerea*, **T. tenella*, *T. belizensis*, *T. nicaraguensis*, *T. rhodantha* and *T. spicata* and probably occur in all species. One specimen of *T. multifolia* (*Mexia 1113*) is noted on the label as exhibiting a slight sensitivity to touch. Stipels are always absent.

Stipules vary from setaceous to lanceolate and are either deciduous or persistent and brown or green in all the endemic species. The conspicuous, ovate, brown or reddish stipules of *T. grandiflora*, a native of South Africa naturalized in Jamaica, are a notable exception. In general stipules are too uniform, exhibiting the same variations from one species to another, to be of much diagnostic value.

[1] Large pieces of epidermis and cuticle of species with relatively rigid, coriaceous leaflets may conveniently be removed from leaflets of herbarium specimens by the method recommended by Bailey and Nast (1948). Leaflets are first boiled in water and then macerated in equal parts of 5% nitric and 5% chromic acids at 56° C. Two to four hours are sufficient for most *Tephrosia* species, depending upon the thickness of the leaflets. This method is unsatisfactory with thin-leaved species, such as *T. virginiana*, *T. Sinapou*, *T. spicata*, etc.

TABLE 3

Areoles, Stomata and Glands of Indigenous American Barbistyled Tephrosias

	Isodiametric (+), elongate (−), or intermediate (±) areoles between lateral veins of leaflets	Presence (+) or absence (−) of stomata in upper epidermis of leaflets	Presence (+) or absence (−) of glands on	
			Leaflets	Legume
1. *T. multifolia*	−	+		
2. *T. foliolosa*	−	+		
3. *T. macrantha*	−	+		
4. *T. Sinapou*	−	+	−	+
5. *T. leiocarpa*	−	+		
6. *T. Conzattii*	−	+		
7. *T. cuernavacana*	−	+		
8. *T. leucantha*	−	+		
9. *T. Thurberi*	−	+		
10. *T. virginiana*	−	+		
11. *T. onobrychoides*	−	+	−	+
12. *T. rhodantha*	−	+	−	+
13. *T. cana*	−	+		
14. *T. Palmeri*	−	+		
15. *T. Rugelii*	−	+		
16. *T. spicata*	−	+	−	+
17. *T. hispidula*	−	+	−	+
18. *T. florida*	−	+	−	+
19. *T. chrysophylla*	−	+		+
20. *T. tepicana*	+	+		
21. *T. madrensis*	+			
22. *T. Lindheimeri*	−	+	−	−
23. *T. potosina*	−, ±	+	−	−
24. *T. saxicola*	+, ±	+, −	+	
25. *T. Seemannii*	+	−	− ?	
26. *T. Pringlei*	−	+	+	
27. *T. nicaraguensis*	+	−		− ?
28. *T. submontana*	+, ±	−	+	
29. *T. nitens*	−			
30. *T. hypoleuca*	?			
31. *T. vernicosa*	+	−	+	
32. *T. pogonocalyx*	+	+, −	+	
33. *T. belizensis*	−, ±	−	+	+
34. *T. mexicana*	+, ±	+, −	+	+
35. *T. Langlassei*	+	+, −	+	
36. *T. simulans*	+	−	+	
37. *T. quercetorum*	+, ±	+	+	
38. *T. Watsoniana*	+	−, +	− ?	
39. *T. crassifolia*	+	+, −	+	
40. *T. lanata*	+	−	+	
41. *T. Abbottiae*	+	−, +	+	− ?
42. *T. pachypoda*	+	−		
43. *T. major*	+	−		
44. *T. diversifolia*	+	−		
45. *T. platyphylla*	+	−		

Indument.—The indument is of appressed, spreading, recurved or retrorse, simple, bicellular trichomes, varying in length from about 0.1 mm. to 3 mm. These hairs are often somewhat bullate with the short basal cell slightly enlarged. Trichomes are present at least on the lower surfaces of the leaves, on the pedicels, the calyx, the back of the banner and the upper suture of the ovary. The hairs are often twisted and curled in four species with very large and coriaceous leaves.

Small, flat, obovate or club-shaped glandular hairs composed of 8–10 cells in a single layer occur on the leaflets and legumes of some species. These are so inconspicuous as to pass unnoticed even under a powerful dissecting microscope and unfortunately it was not until near the end of this study, when the epidermis of leaflets was examined under a compound microscope, that these were noticed. As a result, the distribution of the glands has been only partially determined (Table 3).

The wide variation in the use of terms descriptive of pubescence makes it desirable to attempt a redefinition and reapplication of most of these, at least for the purposes of this paper. It seems particularly desirable to distinguish between the "morphology" of the indument (i. e., the nature of the individual hairs and the way in which they are arranged) and the over-all effect of the pubescence. (See Constance 1949.)

In describing the morphology of the indument, six terms are most frequently used here. These indicate the approximate length of the trichomes and whether they are appressed or spreading. Strigillose, short-strigose and strigose designate appressed hairs, while the parallel series, hirtellous, hirsutulous and hirsute, indicates ascending or spreading hairs. There is, of course, no sharp line between the various lengths, but, as delimited below, these terms have proved to be of definite value.

Strigillose and *hirtellous:* with minute trichomes 0.1–0.5 mm. long.
Short-strigose and *hirsutulous:* with trichomes about 0.6–1.5 mm. long.
Strigose and *hirsute:* with trichomes more than 1.5 mm. long.
Tomentose: the indument dense, composed of relatively fine, twisted or tortuous hairs, somewhat tangled together and matted. This type occurs chiefly in *T. pachypoda*, *T. major*, *T. diversifolia* and *T. platyphylla.*
Villous: the indument of soft, often somewhat twisted, but not matted, spreading hairs more than 2 mm. long.

The terms sparse, thin, moderate and dense, although admittedly indefinite, have been employed to indicate the relative abundance of pubescence in connection with the terms above.

Such terms as sericeous (or silky), pilose, lanate (or woolly), velutinous (or velvety), shining, dull, canescent and soft are descriptive of the over-all effect of the pubescence and have been employed only in a supplementary descriptive capacity.

As a taxonomic character, pubescence was greatly over-emphasized by Rydberg, and this factor alone accounts for much of the difficulty in the use of his keys. In many species, the pubescence of the vegetative parts is either spreading or appressed and is of varying lengths. Several pubescence-types often occur within the same colony, yet some of these have been given specific or varietal rank. (See the accounts of *Tephrosia onobrychoides*, *T. spicata* and *T. virginiana*.) In some instances, however, the nature of the pubescence is a useful character in conjunction with other features of the plant. The retrorse hairs of *Tephrosia Thurberi* are, for example, correlated with very narrow but deciduous bracts and provide a valid criterion in the determination of fruiting specimens from which the bracts have fallen. In general, the indument of vegetative parts is variable and must be used with caution.

The pubescence of the legume and of the calyx is in some cases more stable. The length of the hairs on the ovary and legume provides a simple method for distinguishing *T. hispidula* from depauperate specimens of *T. florida*. *Tephrosia foliolosa*, a very poorly known species, is separable from *T. multifolia* by minute pubescence, all of one length, on the calyx. That of *T. multifolia* is double, both hirtellous and hirsutulous or strigillose and short-strigose.

Inflorescence.—The structure of the inflorescence is one of the most distinctive features of the genus. Inflorescences are characteristically "racemose" in appearance with the flowers either in 2's or, more commonly, in clusters or "fascicles" at one to fifty nodes. Each of these clusters is borne in the axil of a leaf or of a *primary bract* homologous with a leaf.[1] A cluster is composed

[1] The inflorescence of *Tephrosia Rugelii* shows varying degrees of the reduction of a multifoliolate leaf to a lanceolate bract. In this species, at least one and often as many as five flowering nodes of the inflorescence bear leaves. On some plants the lowermost of the leaves is an apparently normal vegetative leaf with from 9 to 15

of two to seven, or more, crowded flower buds, each of which is subtended at the base of the pedicel by a secondary bract.[1]

At least two of the buds at a node flower, while one or more may remain rudimentary. In the instances in which only two buds are present at a node, both of these flower simultaneously and anthesis proceeds centrifugally, as in *Tephrosia virginiana*, *T. Thurberi*, *T. leucantha* and *T. cuernavacana*. In those species in which 3 to 5 flowers are produced at each node, however, one of the lower buds on either side of the primary bract may open first, or both may flower together, to be followed by the third bud which lies directly behind the primary bract, and then by one or more others. In these species the flowering along the inflorescence-axis is more or less irregular, neither centrifugal nor centripetal, with the various nodes behaving somewhat independently of one another.

Although the inflorescences of many species are long and wand-like with well separated nodes, shortening occurs in varying degrees in some members of the genus. In *Tephrosia virginiana* and its allied species, the buds at a node are reduced to two plus a minute rudiment between them, and the nodes of the inflorescence are often very close together and strongly buttressed below. A similar extreme is encountered in *T. platyphylla* in which the inflorescences are very short and the buds few, while the leaflets are reduced to one or three. The inflorescence of *T. grandiflora* is composed of few flowering nodes (3 to 5), each with two functional buds and no external trace of the secondary bracts. The primary bracts are large, colored and deciduous.

The structure and flowering behavior of the inflorescence of the American species of *Tephrosia* lead to the conclusion that each cluster of buds in the axil of a primary bract or leaf represents an axillary branch-system in various degrees of reduction. Each

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leaflets. At successive nodes upward, however, the leaflet-number is reduced, eventually to a single, petiolate leaflet still with stipules at the base of the petiole. At still higher nodes the leaf and stipules sometimes appear as a deeply three-cleft bract. Eventually a single, lanceolate primary bract is found. Although all of these stages do not always occur, they do provide indications of reduction.

[1] Although the secondary bracts are in varying degrees smaller than the primary bract, in some instances the two outermost are nearly as conspicuous as the primary and may appear to be the stipules of the leaf represented by the primary bract. Cleared preparations, however, clearly show that the vascular traces of the secondary bracts are associated with those of the buds they subtend and not with those of the primary bracts.

"raceme" would then represent a complicated inflorescence, the component parts of which are more or less reduced and shortened.

The *position of the inflorescences* is usually constant in well-developed plants of a species. Three general types may be distinguished. Inflorescences may be (1) terminal or terminal and with shorter branches from the axils of the upper leaves, the terminal inflorescence being best-developed, (2) axillary or primarily so, with the axillary inflorescences first and best developed, or (3) apparently opposite the leaves and terminal (sympodial).

The first type is characteristic of 34 of the 49 species. Axillary inflorescences in this type are usually borne singly, although in *T. foliolosa* and *T. multifolia* two inflorescences are sometimes seen at one node. *Tephrosia multifolia* is somewhat doubtfully placed with this group, however, for although some specimens show well-developed terminal inflorescences, on most herbarium specimens the axillary inflorescences are evidently first and best developed.

Only axillary inflorescences are developed in *Tephrosia cuernavacana*, *T. Conzattii*, *T. lanata*, *T. crassifolia* and *T. bracteolata*. Both terminal and axillary inflorescences are sometimes developed in *T. rhodantha*, but the latter are usually first and best developed. These axillary inflorescences arise from one of the three buds which lie side-by-side in the axils perpendicular to the axis of the leaf. In *T. crassifolia* and *T. lanata* one or two short branches sometimes spring from near the base of an inflorescence or an inflorescence may be accompanied by one or two short inflorescences from the same axil.

The principal inflorescences of *Tephrosia rhodantha* and *T. bracteolata* are peculiar in that they emerge obliquely from the axils (i. e., from the side of the axil). The same type occurs in the otherwise very dissimilar **T. vicioides* Schlecht. The growth of one of the lateral buds in the axil does not seem to be responsible for this peculiar behavior, for in *T. Sinapou* and *T. Conzattii*, at least, some of the axillary inflorescences develop from one of the lateral buds, but in all cases emerge from the axil in the ordinary fashion.

In the third (sympodial) group of species, in which the inflorescences are apparently opposite the leaves or terminal, the inflorescences are actually terminal but may be overtopped by the

strong growth of an axillary branch which produces another terminal inflorescence and an axillary branch. This process may be repeated several times.

Although much has been made of the monopodial versus sympodial method of branching in *Tephrosia*, the distinction between the two is frequently finely drawn, with the additional complication of the two types of axillary inflorescences. It is, for example, frequently quite difficult to determine whether a plant of *Tephrosia onobrychoides* is monopodial or sympodial and this same difficulty is one of the limiting factors in the study of the glabrous-styled species. There is also the striking example of *T. Rugelii* which is monopodial in habit, but undoubtedly most closely related to species of the southeastern United States which are definitely sympodial. A further complication is the occurrence of oblique axillary inflorescences in very dissimilar species in the glabrous- and bearded-styled groups. Monopodial versus sympodial seems to be neither a very usable nor fundamental character within the genus as a whole.

Primary bracts may be either persistent or deciduous and vary from subulate or setaceous to broadly ovate or oval and inflated. These bracts are important taxonomic characters in some instances. Secondary bracts are usually smaller and narrower and are generally of little diagnostic importance.

Bracteoles are rarely present at the base of the calyx or on the pedicels but are regularly encountered in four very different species: *Tephrosia cana*, *T. diversifolia*, *T. Abbottiae* and *T. pogonocalyx*. One to three linear to subulate bracteoles may sometimes be found on the pedicels of *T. virginiana* and *T. Thurberi*, also.

Pedicels vary in thickness from one species to another, but characteristically elongate somewhat and thicken in fruit. Pedicel-length is a reliable character only in widely separated species.

Calyx.—The five-lobed calyx is persistent in all American species except **T. sessiliflora*, an anomalous plant in which the calyx is circumscissile at the base after anthesis. The upper lobes are usually shorter than the lowermost and are more or less united. Although in the past emphasis has been given to the length of the calyx-lobes and -tube, variation is found in the

length of the lobes within a species, so that care must be taken to include the full range. The length of calyx-lobes is, however, a useful character. Ratios of length of lobes to calyx-tube are variable, difficult of application and of little value, although the genus has been divided into subgenera partly on this basis (see RELATIONSHIPS). Shape of the lobes is relatively constant in most cases and furnishes an important taxonomic character.

Corolla.—All five petals of the papilionaceous corolla are clawed. The length of the claw is in some instances characteristic of a species. The banner is generally suborbicular to obovate and, in all of our species, more or less hairy on the back. A yellowish-green, apparently glandular area is present at the base of the blade within, but is frequently difficult to see in herbarium material and is seldom reported.

The wing-petals vary from oblong to obovate; the shape is not reliable. A small basal auricle is often present on the upper side of the blade near the base. The keel-petals, which are united at the outer end, may be with or without a basal auricle. For the purposes of corolla-measurement the keel is most satisfactory, for it is usually damaged least in drying and is relatively constant in length. Wings and keel are lightly coherent near the base of the blades; both are glabrous.

Corolla-color is seldom reported, but offers interesting possibilities. However, a tendency for a color-change to occur as the flowers age necessitates careful field-observation. Apparently in all of the species with a free vexillary stamen and in *T. onobrychoides* the corolla is white (or yellowish on the back of the banner), becoming pink and then carmine with age or violet in drying. The flowers of *T. leucantha* and *T. Thurberi* are white, becoming violet in age, while those of the related *T. virginiana* are bicolored with white or yellowish banner and rose wings and keel as, perhaps, are those of *T. nicaraguensis*. In contrast, the flowers of *T. Abbottiae* and three closely related species appear to be rose-purple, showing little or no change with age. The same is true of the peculiar pair of species, *T. Lindheimeri* and *T. potosina*, which have no evident close relatives. A number of other species show this same type of coloration. Data on specimens of *Tephrosia Sinapou* are confusing, but the few growing plants I have seen bore white flowers with violet markings on the

upper side of the wings near the base. The flowers of most of the glabrous-styled American species appear to be rose-purple or Liseran purple (Ridgeway) but at least one introduced species of this relationship seems to have white flowers.

Androecium.—The stamens are either monadelphous with the vexillary (uppermost) stamen free only at the base, or diadelphous with the vexillary stamen completely free from the other nine. This distinction is relatively constant and is usually observed without difficulty, although a few cases are somewhat dubious, mostly for lack of material (*Tephrosia madrensis*, *T. tepicana* and *T. bracteolata*). Interestingly enough, most of the relatively small group of diadelphous species (which have herbaceous habit and white flowers) seem to be rather closely related to each other, more so than to other members of the genus.

A more or less prominent, often two- or three-lobed thickening is frequently observed on the upper side of the vexillary stamen near the base. The margins of the staminal tube on either side of this callosity are also thickened, sometimes conspicuously so, as in *T. macrantha*, in which a knob-shaped structure is present.

Filaments and anthers are unappendaged. The anthers are uniform in size and arranged in two equal, alternating series, one above the other.

Gynoecium.—The sessile ovary is surrounded at the base within the staminal tube by a saucer- or collar-like disc characteristic of the Subtribe Tephrosiinae of the Tribe Galegeae. Four to sixteen ovules are borne along the upper suture, alternating ovules being attached to either valve. Ovule-number exhibits characteristic variations which are more or less clearly reflected in seed-number. There appears to be a tendency toward reduction in ovule-number in the genus. The 10 to 16 ovules of *T. rhodantha* distinguish it from other species of its group, while *T. Lindheimeri* and *T. potosina* at the other extreme bear but from 4 to 8. Among the smooth-styled species, **T. cinerea*, with from 10 to 12 (rarely as few as 8) ovules, is readily separated from other species, with 6 to 8.

The style may be glabrous or barbate with fine white hairs along the inner (upper) side. In all of the species with which this revision deals the style is more or less barbate. The glabrous-styled group includes all of the species with small

purple flowers, such as *T. *cinerea*, *T. *tenella* and *T. *Senna*, as well as the very aberrant *T. *sessiliflora*. In all species the stigma is terminal, small and penicillate. Tufts and rings of hairs are absent from the style.

Fruit.—In all of the American species, the two-valved, strongly dehiscent legume is essentially linear and most often nearly straight, although an upward or downward curvature is exhibited by several species. One to four pods are borne at a flowering node. Those of *T. macrantha* and *T. multifolia* characteristically droop, while all others are ascending or spreading. The persistent style-base forms distally on the upper side of the legume a more or less prominent beak which effectively distinguishes the legume of *Tephrosia* from the equally tapered pods of *Galega*. Pubescence, width and length of the legume and the number of seeds are the most useful characteristics, provided fully developed pods are chosen. Pubescence is, however, sometimes deceptive. A layer of elongated, thick-walled cells arranged diagonally below the epidermis gives the ripening legume the striate appearance remarked by Rydberg (1923) and apparently is responsible for the rupture of the ripe pod and the coiling of the valves.

Seeds.—The seed-coats of all of the indigenous species are smooth and usually of various shades of brown or gray, variegated with black. Two notable exceptions are the closely-related *T. Lindheimeri* and *T. potosina*, the seeds of which are buff or stramineous and unmarked. In the introduced species, *T. *noctiflora*, the seed-coat is reddish brown and strongly wrinkled. The large, flat, black seeds of another introduced species, *T. *Vogelii*, bear a conspicuous white caruncle, which is seen to a lesser degree in the related species, *T. *candida*. In other species the caruncle is usually inconspicuous. Characteristic variations in seed-shape from subspherical to cylindric to compressed and more or less reniform in outline occur, but crowding within the pod strongly influences both shape and size. The subglobose seeds of *T. *chrysophylla*, *T. *florida* and *T. *spicata* contrast markedly with the cylindrical seeds of *T. *tenella* and *T. *cinerea* or those of *T. *Vogelii*, *T. *noctiflora*, *T. *Lindheimeri* or *T. *potosina* mentioned above. Comments on the internal morphology of the seeds of several species have been published by Martin (1946).

Measurements

All measurements included in the descriptions of species have been taken directly from dried herbarium-material, with the exception of those involving flower-parts. The data relative to flower-parts are either from specimens preserved in alcohol or from flowers expanded by boiling. Length of the dried flower as encountered in herbarium-material has been indicated in most instances, but is not significant in more than a general way, since the petals (in particular the banner) often crumple or shrink in drying.

Length of the *inflorescence* includes the peduncle between the lowermost flowering node and the next lower leaf. In most instances the length of the peduncle is noted separately as well.

Calyx-length has been measured in all instances along the upper side from the receptacle to the tips of the upper lobes. Length of the calyx-tube, where indicated, is measured between the upper and lateral lobes. The upper calyx-lobes are measured from the base of the sinus between them to the tips of the lobes. *All measurements of calyx-parts have been made from flowers at anthesis.* The relative proportions of the lobes, as well as their shape and length, change from bud to flower and from flower to fruit.

Length of the blade of the *banner* and of the claw are given separately since the banner is strongly reflexed, making measurement difficult. All measurements of *wings* and *keel-petals* include the claw, however. The keel is measured from the proximal tip of the claw to the apex of the keel.

The *staminal tube* has been measured along the lower side and does not include the full length of the stamens.

Length of the *legume* does not include the persistent base of the style which, in most instances, forms a beak on the upper side.

Relationships

Tephrosia, in the sense used in this paper, is a natural genus defined on the basis of a number of characters. These include the collar-like disc surrounding the base of the ovary, the imparipinnate leaves, the simple trichomes, the terminal penicillate stigma, the unappendaged equal anthers, the pubescent back of the banner, the wings slightly coherent with the obtuse keel, the

absence of stipels, the peculiar inflorescence and the apparently uniform occurrence of 11 pairs of chromosomes. Some of these characters are shared in various combinations with presumably related genera, but others, such as inflorescence and chromosomes, set the genus apart.

Although various relationships have been assigned to *Tephrosia* within the Tribe Galegeae, this question is badly in need of critical examination in terms of the whole plant, a project far beyond my present scope. In order to give a general idea of likely relationships, however, it may be noted that Taubert (1894) placed *Tephrosia* in the Subtribe Tephrosiinae along with *Galega* L., *Ptychosema* Benth., *Sylitra* E. Mey., *Mundulea* DC., *Millettia* Wight & Arn., *Wisteria* Nutt., *Fordia* Hemsl., *Sarcodum* Lour., *Platysepalum* Welw., *Poecilanthe* Benth., *Chadsia* Boj., *Barbieria* DC., *Peteria* A. Gray, *Poissonia* Baill. and *Bolusia* Benth.

Rydberg (1923a), considering the North American representatives of this group, divided the Tephrosiinae into two subtribes, the Craccanae, including *Galega*, *Cracca* L. (= *Tephrosia*) and *Peteria*, and the Millettianae with *Kraunhia* Raf. (= *Wisteria*). The general reliability of this bit of classification may be judged by Rydberg's statement regarding *Barbieria* which he placed in a subtribe of its own considerably removed from the Craccanae and Milletianae: "The Tephrosieae of Bentham (Tephrosiinae of Taubert) is in itself not a natural division, for *Barbiera* is not at all closely related to the rest, being distinguished by the long-clawed petals, the presence of 2 bractlets beneath the tubular calyx, and the style bearded along the upper side." This general idea may possibly be true, but the evidence presented is hardly convincing, for there are 45 endemic American species of *Tephrosia* with bearded styles and 4 of these bear bracteoles on calyx or pedicels.

Tephrosia itself has been variously divided into sections, but until much more of the Old World material can be examined it seems neither feasible nor wise to attempt to establish further formal subgeneric groups, although it is certain that a realignment will be necessary. It may, nevertheless, be worthwhile to indicate some of the possible subdivisions.

It appears to me that two principal divisions within the genus must be based on glabrous styles versus barbate styles. Although this may seem to be an arbitrary division based on a single character, it is perhaps the same type of distinction as the presence or absence of chaff or bristles on the receptacle of the Compositae which sets off large and presumably related groups of genera. Such a split in *Tephrosia* is apparently fundamental within the New World species, at least, as is borne out by related species which lead from one small group of species to another (although there are gaps). In general, the two series are composed of very different species and parallel series are not found in the two divisions, although such features as unifoliolate leaves, sympodial branching, oblique axillary inflorescences and similar flower-color may appear in otherwise quite dissimilar species.

It may also prove desirable to recognize a small, closely knit barbistyled group of species of southern Africa which includes *Tephrosia grandiflora* and its allies with large stipules and ovate, spathaceous primary bracts. Secondary bracts are completely absent. This alliance has been designated Section *Apodynomene* (E. Mey.) Harvey, Fl. Capensis **2**: 203. 1861.

There are at least two other small groups which are probably not worth recognition, but with which I am poorly acquainted. These are the sections (or genera) *Pogonostigma* and *Requienia* which include a few African species with 1-seeded fruits. The leaves of the first are compound, those of the second unifoliolate. Should these prove to be worthy of the sectional rank assigned them by Taubert, the remainder of the genus may well be designated *Eutephrosia* Harvey, Fl. Capensis **2**: 203. 1861.

The main body of the genus (*Eutephrosia*, including both barbate- and glabrous-styled species) has customarily been divided since the time of DeCandolle into the Sections *Brissonia* (Moench) DC. and *Reineria* (Neck.) DC., but these are artificial groups based upon a combination of habit (monopodial vs. sympodial) and the ratio of length of calyx-lobes to -tube, characters which are not necessarily correlated with one-another. (See Morphology: *Habit*, *Calyx* and *Inflorescence;* also Rydberg 1923a.) Rydberg (1923) established 17 small, completely new sections for the North American species, but some of these are

manifestly artificial and none can be rearranged or retained satisfactorily in terms of the whole genus.

Although it would be gratifying to be able to set down a chart showing the phylogeny of the American barbistyled species, the interrelationships of these plants are far from clear. Some small groups or pairs of species are clearly related to each other, and the group as a whole may be divided into two main complexes, but even after this there are a number of species apparently not very closely related to each other or to any of the small groups. The interrelationships of the latter are not very clear, either.

It must, as a result, suffice to point out that the American species fall into two principal series. The plants of the first series (A) (including Species 1 to 23) possess thin leaflets bearing stomata in the upper epidermis. The areoles between the principal parallel lateral veins are distinctly elongate. The second series (B) (Species 24 to 45) includes species with either thin or very coriaceous leaflets, generally with nearly isodiametric areoles between the lateral veins of the leaflets, and usually with few or no stomata in the upper epidermis. A strong tendency toward reduction in the number of leaflets is encountered in this series and the flowers of most of the species seem to be rose-purple.

Within Series A, two distinct subdivisions may be recognized, according to the coherence of the vexillary stamen with the staminal tube. In five closely related species of the southeastern United States, in the two species occurring in Baja California, in *Tephrosia tepicana* and in *T. madrensis* from the Sierra Madre of Sinaloa and Nayarit, Mexico, and in the more widespread *T. rhodantha*, the vexillary stamen is completely free from the staminal tube, even in the smallest buds (Species 12 to 21; see Key 2). These are all herbaceous, white-flowered species which exhibit a tendency toward reduction in leaflet-number. In the remainder of the species of Series A, the vexillary stamen is coherent with the staminal tube, although free at the base. This subdivision embraces both woody and herbaceous types. The basic flower-color appears to be white, although at least *T. virginiana* has bicolored flowers and *T. potosina* and *T. Lindheimeri*, placed here although apparently not closely connected with any of the other American species, bear rose-purple flowers. A possible connecting link between the two groups of Series A is

found in the white-flowered *T. onobrychoides* of the Gulf Coastal Plain of the United States, which approaches the southeastern species in habit and general appearance but in which the vexillary stamen is fused with the staminal tube.

Various exceptions to the general characters distinguishing the two principal groups will be noted in Table 3. Within Series A the areoles of the leaflets of *T. tepicana* and *T. madrensis* are distinctly isodiametric, although stomata are present in the upper epidermis of at least the former. The material of these two is very scanty but the vexillary stamen appears to be free, thus linking them with similar members of this group. Conversely, the areoles of *T. Pringlei* of Series B are conspicuously elongate and stomata are invariably present in the upper epidermis of the leaflets, but this plant is otherwise allied to *T. Seemannii* and *T. saxicola*. Similarly, the areoles of *T. nitens* are elongate and those of a number of other species of this group are more or less intermediate in shape, although other characters clearly link them with this assemblage.

The relationships of various pairs or small groups of species, in addition to those already mentioned, are brought out in the discussions of individual species. A branching system of relationships or a brush-heap structure would undoubtedly be far more satisfactory than the linear sequence which must necessarily be used, for I suspect that woody types of Series A with relatively many leaflets and flowers at a node, such as *T. multifolia* and *T. Sinapou*, have led to more specialized forms, such as *T. virginiana*, *T. Conzattii* and *T. leiocarpa*, and have led as well to those with a free vexillary stamen and to Series B. I have, however, tried to show in their linear arrangement such relationships as seem to be indicated by the morphological features of the plants.

Distribution and Ecology

The barbistyled Tephrosias are primarily North American in their distribution in the New World, with only *Tephrosia Sinapou* and *T. nitens* extending into South America. Outline Maps 1 to 20 indicate the distribution of individual species in North America, and this information is summarized in the accompanying Generalized Distribution Map. Such a generalized map can only indicate the total number of species known to occur in a

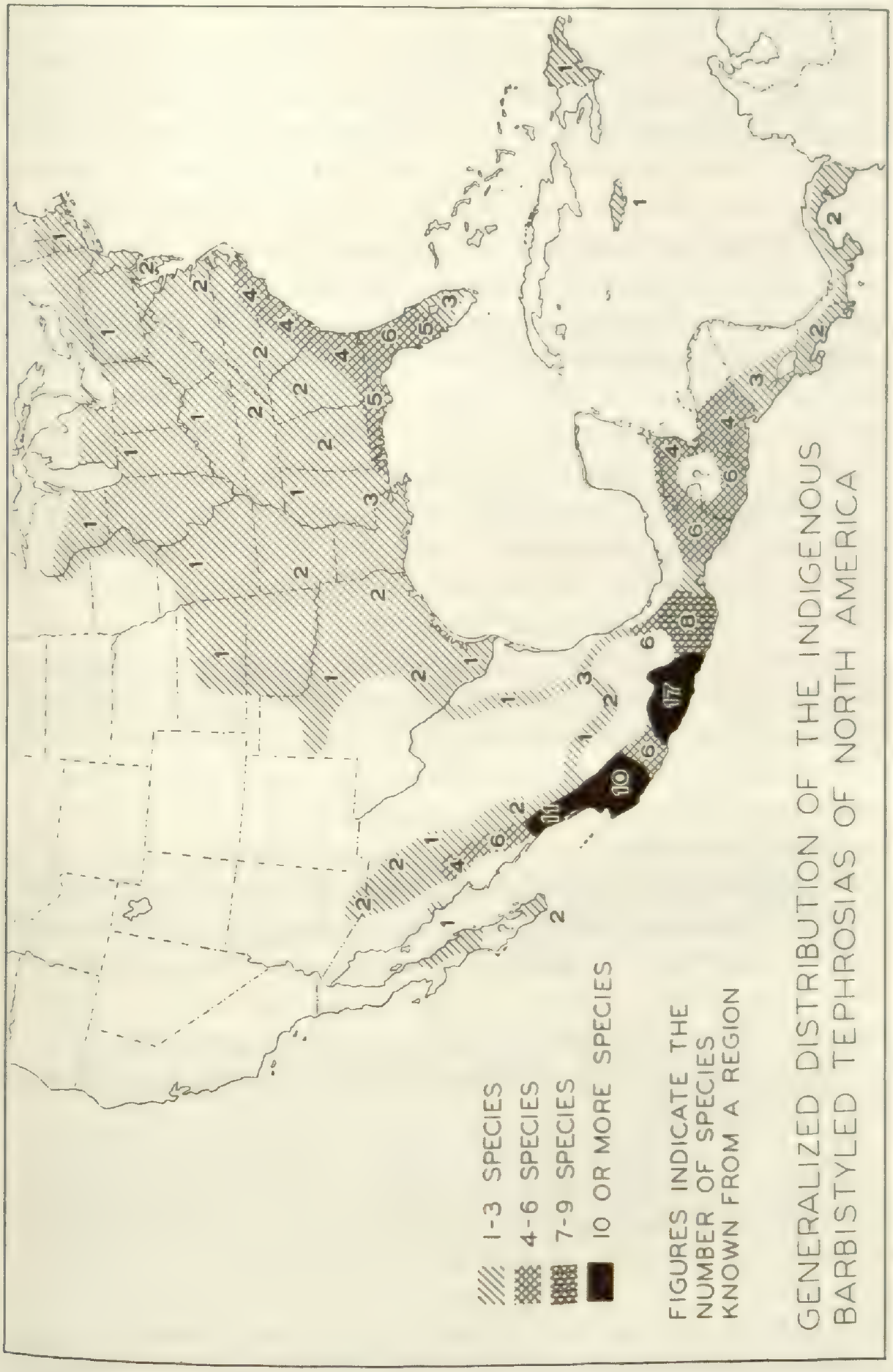
given region, since it is obvious that no two species will have the same range and that distributions will overlap in varying degrees. In addition, the number of species from some areas may be expected to change as our knowledge of Mexico and Central America increases and new species are discovered. Nevertheless, it will be seen immediately that the chief diversity of the barbistyled group is in the mountains of southwestern Mexico,[1] particularly in the region from southern Sinaloa to Guerrero and Morelos (areas in solid black on the map). Twenty-seven of the 45 species are known to occur in this territory and 20 of these are endemic to this area.

Within this region of concentration of species, two divisions apparently exist: a northern part consisting of southern Sinaloa, Nayarit and western Jalisco separated by Michoacán from a southern area including Guerrero, southern México[1] and Morelos. This southern region is in turn subdivided by the lowlands of the Río Balsas into a northern portion (southern México, Morelos and northern Guerrero) and a southern portion (the remainder of Guerrero south of the Río Balsas). Eleven barbistyled species of *Tephrosia* are known from each of these areas and a total of 17 from the two together. The decrease in concentration represented by Michoacán with only 6 species may be more apparent than real since much of the western part of the state which may be expected to harbor Tephrosias is as yet largely unknown botanically and otherwise.

Outside this rich band of mountainous country with 27 species the number of species declines rapidly, although some endemism is still evident, for only a few types are really widespread, extending from various parts of Mexico varying distances into Central or South America. These widespread species include *Tephrosia nicaraguensis*, *T. multifolia*, *T. nitens*, *T. Sinapou* and *T. rhodantha*.

Of the eight species known from Oaxaca, only one (*T. Pringlei*) is confined entirely to that state. The others are shared to the north, west or east. One type of distribution also seen in other genera is exemplified by *T. Conzattii*, represented from Oaxaca, Guerrero and southern México, and another in *T. Langlassei*,

[1] In order to distinguish between the Republic of México and the State of México, the English spelling is used throughout for the republic and the accented Mexican form for the state.


GENERALIZED DISTRIBUTION OF THE INDIGENOUS
BARBISTYLED TEPHROSIAS OF NORTH AMERICA
FIGURES INDICATE THE
NUMBER OF SPECIES
KNOWN FROM A REGION
1-3 SPECIES
4-6 SPECIES
7-9 SPECIES
10 OR MORE SPECIES

which extends both north and west and then southward into Chiapas. Still another distribution is that of *T. belizensis*, reaching from Veracruz across the northern side of Oaxaca into Chiapas and British Honduras. In Veracruz, *T. lanata*, in addition to *T. belizensis* and *T. Langlassei*, extends along the slopes of the eastern sierra southward and eastward; the other three species occurring in Veracruz are widespread.

Guatemala can claim at present only one endemic species, and that an undescribed, distinct but sterile plant collected by Steyermark in the Department of Huehuetanango (see Species 21). The other six species (the undescribed plant was omitted from the generalized map) include five widely distributed types and *T. lanata*. Southward from Guatemala the number of species decreases and only *T. multifolia* and *T. nitens* are known to reach Panama. It is strange that *T. Sinapou* has not been collected beyond El Salvador, for it has a wide distribution in South America and appears in the West Indies.

No collections of *Tephrosia* are known to me from Hidalgo, Puebla, Aguascalientes, the higher parts of México, and most of eastern and northern Jalisco and Michoacán, although two species reach the northern side of this area in the oak forests of Guanajuato and Querétaro, and one extends northward again to a corner of Tamaulipas.

Eleven barbistyled Tephrosias occur in the United States. *Tephrosia leiocarpa* and *T. Thurberi* reach the mountains of southern Arizona and *T. potosina* extends from San Luis Potosí into Texas, where its range meets that of the related *T. Lindheimeri*. This last species has not yet been collected in Mexico but is not uncommon in southern Texas to the Mexican border at the Río Grande.

The most widely distributed species in the United States is *Tephrosia virginiana*, which is found from New Hampshire to Wisconsin and south to Florida and western Texas. *Tephrosia onobrychoides* occupies a part of the Mississippi embayment of the Gulf Coastal Plain. The remaining five species, all plants with the vexillary stamen free, radiate more or less concentrically northward from central peninsular Florida, with *T. Rugelii* occupying the smallest and *T. spicata* the largest area, the latter extending well off the Coastal Plain. Plants presumably most

closely related to these five species occur in Baja California, western and southern Mexico, and Guatemala.

Each of these present-day distributional patterns is, of course, delimited by the area covered by the particular set of environmental conditions to which that species is attuned. Each distribution must also reflect to some degree both the history of the species and geological history. Presumably, most of these species already occupy the suitable habitats now available to them and are prevented by unfavorable environmental conditions from expanding their ranges farther. An attempt to explain distributions with only the present data from which to judge would be both premature and unwarranted, but a number of coincidences are strikingly suggestive and worth underscoring.

Although ecological notes concerning many species of Mexico and Central America are scanty or lacking altogether, it is evident that the majority of the Mexican species are confined to well-drained soils in open oak and/or pine forests in non-calcareous areas mostly below 2300 m. (ca. 7500 feet). Exceptions are found in relatively wide-ranging species such as *T. multifolia*, *T. rhodantha* and *T. nitens*, which may occur outside the oak-pine forests in open areas at low altitudes, and in *T. leucantha* of oak and pine forests southward from northwestern Chihuahua to Guanajuato and Querétaro, where it may be found at 2500 m. (8000 feet). It may be significant that the greatest diversity of the barbistyled group is in mountainous regions in which rain is lacking during winter and spring and the winters themselves are warm.

Part of the absence of the genus from Hidalgo, Puebla, Aguascalientes, eastern and northern Jalisco and Michoacán and the higher parts of México (assuming that this absence is real and not due to insufficient collecting) may be attributed to semi-desert conditions which occupy a portion of this expanse. In Hidalgo, where extensive search has failed to reveal a single species of *Tephrosia*, it is perhaps significant that oak and pine forests where Tephrosias might be expected to occur are primarily on soils of calcareous derivation, whereas apparently non-calcareous soils are the rule in those parts of Mexico where numerous species have been collected.

In the United States *Tephrosia virginiana*, *T. onobrychoides* and the five species of the southeastern states are always found in open habitats in non-calcareous soils. All of the stations of *T. onobrychoides* appear to occur on well-drained, leached, sandy, acid, non-calcareous red and yellow podzolic soils of the Norfolk-Ruston, Caddo-Beauregard, Hockley-Katy, Lake Charles-Crawley and Hanceville-Conway series and the species disappears abruptly when the black prairie and other Rendzina soils of the Houston-Austin-Denton and Victoria-Goliad series (derived from marls, chalks and calcareous clays) (U. S. Dept. Agr. 1938) are reached. This coincidence suggests that at the western edge of the range edaphic factors may be limiting, but that other factors at various other points on the periphery of the species may also be limiting, for suitable Norfolk-Ruston soils are widely distributed around the Coastal Plain to Virginia.

Tephrosia Rugelii, *T. chrysophylla*, *T. florida*, *T. hispidula* and *T. spicata*, of the southeastern United States, all occur on sandy soils of the Coastal Plain; the first four are completely restricted to that area, but *T. spicata* extends into well-drained sandy and sand-clay soils over a wider area. *Tephrosia Rugelii* occupies the smallest expanse, being found on sands of the Leon-Bladen and Norfolk-Blanton soils primarily in oak barrens in the flatwoods regions of central peninsular Florida. *Tephrosia chrysophylla* grows prostrate on open white sand in dry oak barrens over a larger range, while *T. florida* occupies a still larger area, always on sandy, but often somewhat more shaded and moister soils. An extreme is reached in *T. hispidula* which is distributed primarily in the grassy and sedgy pine flatwoods along the Atlantic Coastal Plain in sandy soils of the Leon-Bladen and Coxville-Portsmouth-Bladen groups, which may be moist or even wet, in contrast to all the other species with which I am acquainted.

With all of these species the circumstantial evidence strongly suggests that edaphic factors are important in determining distribution. *Tephrosia florida* is, for example, very abundant on the Norfolk sand in Richmond County, North Carolina, in the northern part of its range, but disappears along with the long-leaf pine (*Pinus australis* Michx. f.) as the abrupt transition to the heavier Georgeville-Alamance soils occurs. As was indicated previously, almost all of the barbistyled species are known on

soils of non-calcareous derivation, although some of the glabrous-styled species (as **T. cinerea*) may grow directly on limestone outcrops. The only exceptions of which I am aware are *T. potosina* and *T. Lindheimeri* which, to judge from notes on various herbarium-specimens, may sometimes occur on calcareous soils.

It seems likely, too, that the isolating mechanisms between some of the species of *Tephrosia* are at least partially ecological. As was noted above, *Tephrosia chrysophylla* usually occurs in drier and more open habitats than those occupied by *T. florida*. Occasionally, however, the two species occur together and I have found intermediate plants, presumably hybrids (see Species 19a) only in such localities. Similarly, intermediates (inconclusively hybrids) were found along a road-bank where *T. spicata* grew at the edge of brush and *T. chrysophylla* on the exposed white sand. Another suggestive but inconclusive example was seen in Emanuel County, Georgia. Here *Tephrosia florida* was abundant in open ground between trees of *Quercus incana* Bartr. and *Q. alba* L., while *Tephrosia hispidula* grew in moister, sedgy ground with pines. In a narrow zone of gradation between these habitats plants morphologically intermediate between these two distinct species occurred. Except at this locality, I have never found *T. florida* and *T. hispidula* in contact with one another.

(*To be continued*)

CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD UNIVERSITY—No. CLXX

THE AMERICAN BARBISTYLED SPECIES OF TEPHROSIA (LEGUMINOSAE)

CARROLL E. WOOD, JR.

(Continued from page 231)

SYSTEMATIC TREATMENT

The generic description given below is based on the specimens examined in the course of this study and includes both groups of the New World species. It does not entirely apply to a number of species of the Eastern Hemisphere.

In the treatment of individual species the type-collections or -localities of names are included with the synonymy. Types and isotypes which have been examined are indicated by the herbaria in which they are deposited.

TEPHROSIA Pers.

Cracca L. Sp. Pl. 752. 1753, not Medic. 1789, nor Benth. 1853. Type-species: *C. purpurea* L.

Colinil Adans. Fam. **2:** 327. 1763. Substitute name.

Tephrosia Pers. Syn. Pl. **2:** 328. 1807. *Nomen conservandum.* Type-species: *T. villosa* (L.) Pers. not (Michx.) Pers.

Kiesera Reinw. Syll. Ratisbonn. **2:** 11. 1828. Type-species: *K. sericea* Reinw. (= *Tephrosia candida* DC.).

Xiphocarpus C. Presl, Symb. Bot. **1:** 13. pl. 7. 1830. Type-species: *X. martinicensis* Presl (= *Tephrosia candida* DC. introduced into Martinique).

Apodynomene E. Mey. Comment. Pl. Afr. Austr. 111. 1835. Type-species: *A. grandiflora* (L'Her. ex Ait.) E. Mey. based on *Tephrosia grandiflora* (L'Her. ex Ait.) Pers.

Balboa Liebm. (Type-species: *B. diversifolia* Liebm.) and *Crafordia* Raf. (Type-species: *C. bracteata* Raf.) usually assigned to this synonymy are not *Tephrosia*. See Excluded Species.

Erect, decumbent or prostrate perennial herbs or shrubs, usually from a woody crown and heavy woody roots, many species producing rotenone and related compounds. Stems branching either monopodially or sympodially. Pubescence primarily of simple, bicellular hairs 0.1–3 mm. long, these straight, twisted or curling. Minute, flattened 8–10-celled clavate glands of a single layer of cells sometimes present. Leaves 1–41-foliolate, the rachis and sometimes the petioles channeled on the upper side; stipules present, persistent or caducous, usually herbaceous, rarely rigid or spinescent; leaflets petiolulate, estipellate, usually with prominent, nearly parallel veins given off obliquely from the midrib, variously reticulate between; the upper epidermis with or without stomata, glabrous or hairy, the lower surface always with hairs. Inflorescences terminal, axillary or apparently opposite the leaves, in the last actually terminal but overtopped by an axillary branch which may bear a terminal raceme and another axillary branch, a process which may be repeated several times; axillary inflorescences 1–3 from an axil, sometimes obliquely inserted; inflorescences pseudo-racemose, with the flowers in clusters or fascicles at 1 to many nodes, each node with a leaf or primary bract and each of the (2–)3–10 flower-buds with a secondary bract at the base of the pedicel (except in *T. grandiflora*), the bracts persistent or caducous; at least two flower-buds developing and flowering, one or more usually rudimentary; bracteoles on calyx or pedicels usually absent, but present in a few species. Calyx persistent (or circumscissile at the base after anthesis in **T. sessiliflora*), 5-lobed, the lobes usually unequal, the upper pair more or less united and shortest, the lowermost lobe longest. Petals clawed; blade of the banner more or less orbicular, hairy on the back, often sericeous; the wings lightly coherent with the glabrous keel-petals near the base of the blade; wings and keel-petals with or without a small basal auricle on the upper side; keel usually obtuse, not beaked, or only slightly so. Stamens monadelphous, the filaments connate in a glabrous tube with the vexillary stamen free at the base, or diadelphous with the vexillary stamen completely free; anthers uniform, in two series, unappendaged. Ovary sessile, 4–16-ovulate, surrounded at the base by a collar-like disc within the staminal tube; style glabrous or barbate on the upper (inner) side. Legume sessile, linear, straight or slightly curved, usually compressed, 2-valved, not partitioned between the seeds within, obliquely contracted distally and beaked on the upper side by the persistent style-base; sub-epidermal layer of cells thick-walled and elongate, arranged obliquely, the valves often cracking along these lines at maturity and appearing striate; seeds subglobose to cylindrical or compressed and oblong-reniform in outline, estrophiolate. Somatic chromosomes 22.

Distribution. Several hundred species widespread in warm-temperate and tropical regions of both hemispheres, especially in Africa, North America and Australia; absent from Europe.

Artificial Key to the Species

(This key is based primarily on flowering material. For terminology and methods of measurement see Morphology and Taxonomic Criteria and Measurements.)

A. Style barbate.
  B. Ovary glabrous on the valves, strigillose along one or both sutures; legume hirtellous to strigillose along the sutures or completely glabrous. .....Key 1
  B. Ovary pubescent; legume hairy: hirtellous or strigillose to strigose, hirsute, villous or tomentose.
    C. Vexillary stamen completely free from the staminal tube.....Key 2
    C. Vexillary stamen united with the tube but free at the base.
      D. Staminal tube 18 mm. or more long; keel 21–34 mm. long...Key 3
      D. Staminal tube 10–15 mm. long; keel 10–19(–20) mm. long.
        E. Undersurfaces of the leaflets densely tomentose; leaflets large and coriaceous, usually blunt, 1–11; racemes terminal and axillary.....Key 4
        E. Undersurfaces of the leaflets variously hairy, but not densely tomentose with tortuous, tangled hairs; leaflets 1–41...Key 5
A. Style glabrous. . . See list of species excluded on this character.

Key 1

Ovary glabrous on the valves, strigillose along one or both sutures; legume hirtellous to strigillose along the sutures or completely glabrous.

a. Inflorescences axillary, the lowermost first and best developed; monopodial....*b.*
  b. Primary bracts lanceolate to ovate-lanceolate, acuminate, deciduous; leaflets 13–29; rachis 4–11 cm. long; buds and flowers 2 at a node.....7. *T. cuernavacana*
  b. Primary bracts linear-subulate to linear-setaceous, sometimes persistent; leaflets 15–37; rachis 4–16 cm. long; buds 5–7 at a node.....6. *T. Conzattii*
a. Inflorescences terminal and axillary or apparently opposite the leaves....*c.*
  c. Primary bracts persistent....*d.*
    d. Leaves unifoliolate; inflorescences terminal and axillary. .....21. *T. madrensis*
    d. Leaflets 9–17; plant sympodial, the inflorescences opposite the leaves.....16. *T. spicata*
  c. Primary bracts deciduous....*e.*
    e. Stipules ovate, acuminate, reddish or brownish, persistent; leaflets 9–15; primary bracts large, broadly ovate, acuminate, inflated, reddish, deciduous; legume 9–16-seeded; Jamaica.....46. *T. grandiflora*
    e. Stipules linear-setaceous to linear or lanceolate, green to brownish; leaflets 9–23(–27), linear-oblong to oblong-oblanceolate or elliptic, strigillose beneath; rachis 2.3–7.2 cm. long; primary bracts linear-setaceous, deciduous; legume 6–11-seeded; Arizona, Sonora, Chihuahua and Jalisco.....5. *T. leiocarpa*

Key 2

Vexillary stamen completely free from the staminal tube.

a. Inflorescences terminal and/or axillary, the latter first and best developed and inserted obliquely in the axils, leafless; leaflets principally 11–21....*b.*
  b. Leaflets linear, 2–6 cm. long, 2–4 mm. wide; calyx 2 mm. long; introduced into Hispaniola.....49. *T. bracteolata*

b. Leaflets narrowly elliptic to linear-oblong or elliptic, 1–3.2 cm. long, (3–)4–10 mm. wide; calyx 3.5–6 mm. long; ovules ca. 15; Mexico to Guatemala . . . . . 12. *T. rhodantha*

a. Inflorescences terminal or apparently opposite the leaves or, if axillary, not obliquely inserted . . . . *c.*

c. Inflorescences terminating the principal or axillary leafy branches; flower buds 2–3 at a node; bracts usually deciduous; one or more nodes of inflorescence with leaves; leaflets 3–17, uniform, obovate to narrowly cuneate; peninsular Florida . . . . . 15. *T. Rugelii*

c. Inflorescences generally leafless, or occasionally 1 flowering node with a leaf; bracts persistent, except in *T. cana* . . . . *d.*

d. Legume hirtellous or strigillose with hairs 0.2–0.5 mm. long; ovary strigillose with minute hairs . . . . *e.*

e. Calyx or pedicels with 2 bracteoles; inflorescence congested; calyx densely hairy with white hairs; legume 4–7 cm. long, 4–5 mm. wide, hirtellous; leaflets 7–23; Baja California . . . . . 13. *T. cana*

e. Calyx and pedicels without bracteoles . . . . *f.*

f. Leaflets linear to linear-oblanceolate, 9–45 mm. long, 2–7 mm. wide, 5–13, mostly 9 in number; stipules triangular-lanceolate to subulate, rigid; pubescence of plant white, silvery, tightly appressed; Baja California and Sonora . . . . . 14. *T. Palmeri*

f. Leaflets elliptic or elliptic-oblong, elliptic-oblong to lanceolate or cuneate to obovate . . . . *g.*

g. Leaves unifoliolate . . . . . 21. *T. madrensis*

g. Leaves (3–)5–19-foliolate . . . . *h.*

h. Leaflets 5–11, the upper leaflets of a leaf 3–6 cm. long, 1.3–3 cm. wide, elliptic-oblong to lanceolate, rounded or subcordate at the base, the margins ciliate; flowering nodes 3–18; primary bracts linear-subulate; Sinaloa and Nayarit . . . . . 20. *T. tepicana*

h. Leaflets (3–)5–19, cuneate to obovate, the terminal leaflet 8–35 mm. long, 6–20 mm. wide, or narrowly cuneate to elliptic, 1.8–5.2 cm. long, 2–3 mm. wide; southeastern United States . . . . *i.*

i. Stem and leaves prostrate; leaflets primarily 5–7 (rarely 9–11), coriaceous, shining, cuneate to narrowly obovate-cuneate; petioles 1–5(–7) mm. long, 1/3 or less the length of the lowermost leaflet (including petiolule); inflorescences prostrate . . . . . 19. *T. chrysophylla*

i. Stem prostrate, decumbent or erect; leaflets primarily 7–19, if fewer, the terminal more than 30 mm. long; petioles mostly more than 1/3 the length of the lowermost leaflets . . . . *j.*

j. Petioles of some or all of the principal leaves 0.3–9.5 cm. long, 1–4 times the length of the lowermost leaflets (including the petiolules), or if less, the stems erect or decumbent; leaflets 7–19 . . . . . 18. *T. florida*

j. Petioles of the principal leaves 0.5–1 cm. long, some or all 1/3–7/9(–1) times the length of the lowermost leaflets (including

the petiolules); stems prostrate; leaves prostrate, ascending or erect; leaflets 7–13, predominantly 9..19a. *T. chrysophylla* × *T. florida*

d. Legume short-strigose to strigose or hirsutulous to hirsute on the valves; ovary short-strigose to strigose; axis of inflorescence generally not flattened....*k.*

k. Leaflets 5–13, mostly 9, linear to linear-oblanceolate, 9–45 mm. long, 2–7 mm. wide; stipules triangular-lanceolate to subulate, rigid; pubescence of plant white, silvery, tightly appressed; legume 6.5–7 cm. long, 3–4 mm. in diameter, densely strigillose to short-strigose or hirtellous to hirsutulous with white hairs usually less than 0.8 mm. long, 12–16-seeded; Baja California and Sonora.....14. *T. Palmeri*

k. Leaflets 9–23, not linear or linear-oblanceolate; pubescence generally partially yellowish or rusty, that of the legume spreading; legume 3–6.5 cm. long, 4.5–6 mm. broad; southeastern United States....*l.*

l. Leaflets principally 9–17, oblong-obovate to obovate, elliptic or oblong-elliptic, 11–27 mm. long, 6–13 mm. broad; inflorescences 4–45 cm. long; flowering nodes 2–20; pedicels stout; calyx 6–7 mm. long, the lobes deltoid to lanceolate, long-acuminate, the upper 2.5–5 mm. long, the lateral 3–5 mm. long, the lowermost 4–6 mm. long.....16. *T. spicata*

l. Leaflets principally 13–19, oblong to ovate-lanceolate or narrowly elliptic, 7–22 mm. long, 2–7 mm. broad; inflorescences 1.5–15 cm. long; flowering nodes 1–3(–5); pedicels almost filiform in flower; calyx 3–4 mm. long, the upper and lateral lobes deltoid, abruptly contracted near the tip, 1.5–2.5 mm. and 1.5–3 mm. long, respectively.....17. *T. hispidula*

Key 3

Staminal tube 18 mm. or more long; keel 21–34 mm. long.

a. Leaflets of the principal leaves 3–11....*b.*

b. Leaflets 3–7, oblanceolate, principally 2–7.5 cm. long; lateral and lowermost calyx-lobes triangular, subulate, 6–7 mm. long; Sinaloa.....30. *T. hypoleuca*

b. Leaflets 7–11, narrowly elliptic-oblong or occasionally lanceolate-oblong, 3–7.3 cm. long; calyx 14–16 mm. long, densely villous, the upper lobes 3–8 mm. long, the lateral and lowermost lanceolate or ovate-lanceolate, acuminate, 10–12 mm. long and 11–13 mm. long, respectively; keel 32–34 mm. long, staminal tube 25–27 mm. long; Guerrero.....41. *T. Abbottiae*

a. Leaflets of the principal leaves 11–31....*c.*

c. Upper lobes of calyx almost completely fused, nearly obsolete or rounded, blunt, 0.5–1 mm. long, the lateral lobes rounded-ovate to oblong; introduced species....*d.*

d. Primary bracts oval, acuminate, deciduous; legume 10–12 cm. long, 13 mm. wide.....48. *T. Vogelii*

d. Primary bracts subulate, deciduous; legume 6–9 cm. long, 7–9 mm. wide.....47. *T. candida*

c. Upper lobes of calyx triangular or acuminate, 1.5–2.5 mm. long, the lateral lobes lanceolate-acuminate to lanceolate-subulate or ovate, short-acuminate; indigenous species....*e.*

e. Leaflets 13–31, thin, dull; buds 3–5 at a node; pedicels 8–11 mm. long, slender; claw of keel 5.5–6 mm. long; pods scimitar-shaped, drooping, 5–6.5 cm. long, 4.5 mm. wide, hirtellous.....3. *T. macrantha*

e. Leaflets 11–17, somewhat coriaceous, shining; buds 5–8 at a node; pedicels 5–8 mm. long; claw of the keel 4 mm. long; legumes 7–10 cm. long, 5–7 mm. wide, hirsutulous. ..... 28. *T. submontana*

KEY 4

Undersurfaces of the leaflets densely tomentose; leaflets large and coriaceous, usually blunt, 1–11; racemes terminal and axillary; Sierra Madre of Mexico from Sinaloa to Guerrero.

a. Calyx 5–7 mm. long; primary bracts narrowly deltoid to linear-lanceolate, 1–2 mm. broad ....*b.*
  b. Leaflets 3–5; lateral calyx-lobes deltoid to deltoid-lanceolate, acuminate, 2.5–4 mm. long; legume 4–4.5 mm. long, densely hirsutulous with nearly straight, crowded, erect, lustrous hairs ..... 43. *T. major*
  b. Leaflets 7–11; lateral calyx-lobes ovate to ovate-lanceolate, 4–5 mm. long; legume 4–6.5 cm. long, densely tomentose with tortuous and intertwined hairs ..... 42. *T. pachypoda*
a. Calyx 10–17 mm. long; primary bracts ovate or oval to orbicular, 4–8 mm. broad ....*c.*
  c. Leaflets 1–3; calyx without bracteoles; bracts deciduous; claw of the keel-petals 4.5 mm. long ..... 45. *T. platyphylla*
  c. Leaflets 1–5; calyx with 2 conspicuous oval inflated deciduous bracteoles; claw of the keel-petals 7 mm. long. ..... 44. *T. diversifolia*

KEY 5

Undersurfaces of the leaflets variously hairy, but not densely tomentose with tortuous, tangled hairs; leaflets 1–41.

a. Flower-buds 2 (or rarely 3) at a node, usually only 2 flowering; inflorescences more or less compact, anthesis proceeding centrifugally, both flowers of a pair in anthesis together; bracts deciduous; stems usually erect; leaflets thin, stomatiferous on both surfaces ....*b.*
  b. Primary bracts lanceolate, 2–3 mm. broad, acuminate, the base acute; pubescence of stems upwardly directed; pubescence of legume rusty or tawny, at least along the margins; Chihuahua to Guanajuato and Querétaro ....8. *T. leucantha*
  b. Primary bracts linear to linear-lanceolate, acuminate, rarely more than 1.2 mm. wide ....*c.*
  c. Stems and axis of inflorescence doubly pubescent, both hirtellous with fine, strongly retrorse hairs and hirsutulous with downward- and outward-curving hairs; corolla white, becoming purplish; pubescence of legume rusty; Arizona, Sonora and Chihuahua ..... 9. *T. Thurberi*
  c. Stems and axis of inflorescence with antrorse or spreading hairs; corolla usually bicolored, the banner yellow, the wings and keel rose (rarely white); pubescence of legume white or cinereous; central United States, eastward ..... 10. *T. virginiana*
a. Flower-buds 3–5 or more at a node, 3 or more flowering; anthesis usually irregular; racemes more or less elongate (except in *T. vernicosa*) ....*d.*
  d. Leaflets principally 2–6 mm. wide (rarely 8 mm.); low, decumbent or erect plants with 9–25 leaflets, strigillose to densely strigose or hirsutulous beneath ....*e.*
    e. Inflorescences terminal or axillary, the latter not emerging obliquely from the axils ....*f.*
      Calyx 4–5.5 mm. long, strigillose; calyx-lobes deltoid

to deltoid-ovate, rather abruptly acuminate, the lateral lobes 2.5–3 mm. long.....24. *T. saxicola*

f. Calyx 6–10 mm. long; lateral and lowermost calyx-lobes narrowly triangular-subulate to lanceolate, long-acuminate, 4–7 mm. long; leaflets densely strigose to hirsutulous beneath....*g.*

g. Parallel lateral veins of leaflets prominent, the veinlets forming elongate areoles between them; upper epidermis of leaflets with stomata; Oaxaca....26. *T. Pringlei*

g. Parallel lateral veins of leaflets obscure, the veinlets between them forming nearly isodiametric areoles; upper epidermis lacking stomata; Sinaloa and Nayarit.....25. *T. Seemannii*

e. Inflorescences primarily axillary or some terminal, the axillary inflorescences emerging singly and obliquely from the axils of leaves....*h.*

h. Leaflets linear, 2–6 cm. long, 2–4 mm. wide; calyx 2 mm. long; introduced species, Hispaniola.....49. *T. bracteolata*

h. Leaflets narrowly elliptic to linear-oblong or elliptic, 1–3.2 cm. long, (3–)4–10 mm. wide; calyx 3.5–6 mm. long; Sinaloa to Guatemala.....12. *T. rhodantha*

d. All or most of the principal leaflets 8 mm. or more wide (rarely 6 mm. wide)....*i.*

i. Inflorescences axillary only or, if both terminal and axillary, the latter first and best developed, terminating leafy or naked branches....*j.*

j. Leaflets 5–9, large, coriaceous, the areoles between the principal lateral veins isodiametric or nearly so, the upper epidermis estomatiferous....*k.*

k. Inflorescences lax, often spreading and somewhat recurved, calyx 4–5 mm. long, hirtellous or strigillose, the lobes deltoid, abruptly subulate, the lateral lobes 1.5–3 mm. long; Sinaloa to Guerrero. .....39. *T. crassifolia*

k. Inflorescences crowded, ascending; calyx 6–9 mm. long, densely hirsutulous, the lateral lobes lance-subulate, attenuate, 4.5–6 mm. long; Veracruz to Guatemala.....40. *T. lanata*

j. Leaflets 11–37, membranous, the areoles between the principal lateral veins usually distinctly elongate, the upper epidermis stomatiferous....*l.*

l. Leaflets 11–21; ovules ca. 15; seeds 12–15; legume usually hirtellous.....12. *T. rhodantha*

l. Leaflets 15–37, predominantly 21–35; ovules and seeds 8–10; legume usually hirsutulous.....1. *T. multifolia*

i. Inflorescences terminal, both terminal and axillary or apparently opposite the leaves, not exclusively axillary or singly and obliquely inserted in the axils....*m.*

m. Principal leaflets obovate to broadly obovate-cuneate or orbicular, occasionally elliptic; decumbent herbs, branching sympodially; legume 4–5 cm. long, 7–8.5 mm. wide; ovules 4–8; seeds 4–8, tan or stramineous, unmarked....*n.*

n. Leaflets 5–19, primarily 9–11, densely hirsutulous to nearly glabrous above, but with at least a few appressed hairs near the margins, the margins conspicuously bordered with white hairs; calyx and back of banner with whitish hairs; ovules and seeds 5–6.....22. *T. Lindheimeri*

n. Leaflets 3–9, primarily 5–7, completely glabrous above, the margins not conspicuously bordered; indument of calyx and banner golden; ovules and seeds 4–8.....23. *T. potosina*

m. Leaflets not as above; branching monopodial or sympodial; legume (where known) 3.5–6.5 mm. wide (or –7 mm. in *T. Langlassei*).....*o.*

o. Leaflets 15–41 (except *T. belizensis* 5–19, *T. onobrychoides* 13–29 and *T. nicaraguensis* 9–21); upper lobes of calyx 1–3.5 mm. long, the lateral 1.5–4 mm. long.....*p.*

p. Calyx 5.0–8.5 mm. long, the lateral lobes oblong to obovate, abruptly and usually obliquely short-acuminate, 2.0–4 mm. long, the lowermost lobe lanceolate-ovate to ovate or obovate, 2.5–5 mm. long, 2–4 mm. broad; leaflets 17–41; ovules 10–13; Mexico to Brazil, Bolivia and Peru.....4. *T. Sinapou*

p. Calyx 3.5–7 mm. long, the lateral and lowermost lobes deltoid, lanceolate, or linear-lanceolate, acuminate or subulate, not obliquely so.....*q.*

q. Upper leaflets of a leaf lanceolate or ovate-lanceolate, 2–7.5 cm. long, glabrous and lacking stomata above, moderately to densely strigillose or short-strigose and silky beneath; Veracruz, Oaxaca, Chiapas, Br. Honduras.....33. *T. belizensis*

q. Upper leaflets of a leaf linear-oblong, oblong-lanceolate, oblong, elliptic or linear-oblanceolate, obtuse, rounded or cuneate at the base; upper epidermis with stomata (except *T. nicaraguensis*).....*r.*

r. Ovary and legume strigillose or hirtellous.....*s.*

s. Slender monopodial shrub 2 m. high; leaflets 15–31, oblong to linear-oblong, the base obtuse or somewhat cuneate; vexillary stamen with a 2-lobed callosity on the upper surface near the base; legume curved upward near the distal end; calyx strigillose with cinereous hairs; Sinaloa and Durango.....2. *T. foliolosa*

s. Erect or decumbent herb, monopodial or sympodial, to 1 m. high; leaflets principally 13–25(–29), linear-oblanceolate or narrowly elliptic to oblong-elliptic or elliptic-cuneate; vexillary stamen flat on the upper surface; legume straight or curved downward distally; calyx doubly pubescent, both hirtellous and hirsutulous or hirsute; south-central United States.....11. *T. onobrychoides*

r. Ovary and legume hirsutulous; calyx doubly pubescent.....*t.*

t. Leaflets 9–21, narrowly oblong to oblong to elliptic, the base obtuse or rounded, the areoles between the principal lateral veins nearly isodiametric; legumes spreading, straight or curved downward; ovules and seeds 4–8; erect monopodial herb or sub-

CORRECTION

Through an unfortunate error following the addition of several new species, *Tephrosia nitens* (Species 29, page 336) was altogether omitted from Key 5. This very distinct plant will run through the key properly as far as *w* (pages 241–242) but may bridge the distinctions between the couplets under that letter and beyond. The following characters will serve to distinguish the species from the others given there:

Leaflets 5–13, oblong-cuneate to oblanceolate or linear-oblong, rarely somewhat elliptic, narrowed at the base, 3–7 times as long as broad, coriaceous, glabrous above, densely silky-strigose beneath, the areoles between the principal lateral veins definitely elongate. Primary bracts lanceolate to ovate, acuminate, 5–13 mm. long, deciduous. Calyx 6–8 mm. long, ebracteolate, the upper lobes 2–5 mm. long, the lateral lobes deltoid-acuminate or lance-subulate, 4–5 mm. long. Ovules and seeds 9–13. Legume 4–6 cm. long, 4.5–5.5 mm. wide, hirtellous to strigillose, strongly ascending.

shrub 2–5 dm. high; Chihuahua to Nicaragua.....27. *T. nicaraguensis*

t. Leaflets 15–37, linear-oblong, oblanceolate or occasionally elliptic, the base obtuse to rounded; legumes usually drooping, the distal half somewhat curved upward; ovules and seeds 8–10; erect, monopodial herb or shrub 1–2 m. high; Chihuahua to Panama.....1. *T. multifolia*

o. Leaflets 1–13 (except *T. belizensis* 5–19, *T. onobrychoides* 13–29 and *T. nicaraguensis* 9–21)....*u.*

u. Leaves unifoliolate (or on large plants 1–7 foliolate); ovules 6–7....*v.*

v. Leaflets densely hairy beneath, silvery or silky; calyx 6.5–9.5 mm. long, the lateral lobes 4–7 mm. long; leaflets 1–7.....38. *T. Watsoniana*

v. Leaflets sparsely strigillose beneath; calyx 3.5–5 mm. long, the lateral lobes 1.5–3 mm. long; leaves unifoliolate.....21. *T. madrensis*

u. Leaves 5–13-foliolate (except as noted in (*o.*) above)....*w.*

w. Calyx 4–7 mm. long, strigillose or hirtellous to short-strigose or hirsutulous, the upper lobes 1–4 mm. long....*x.*

x. Ovules 4–8; bracts 5–8 mm. long (or –14 mm. in *T. nicaraguensis*); apex of leaflets acute, obtuse or rounded; leaflets hairy above; legumes hirsutulous to hirsute....*y.*

y. Leaflets 9–21; primary bracts persistent. .....27. *T. nicaraguensis*

y. Leaflets 5–13; primary bracts usually deciduous....*z.*

z. Leaflets 7–13, membranous, silky-strigillose beneath; pedicels 5–7 mm. long; upper calyx-lobes 1–2 mm. long....34. *T. mexicana*

z. Leaflets 5–11, thin but rigid, somewhat coriaceous, hirsutulous and pilose beneath; pedicels 7–14 mm. long; upper calyx-lobes 3–4 mm. long.....36. *T. simulans*

x. Ovules 9–11; bracts persistent or deciduous; legumes hirtellous (or in *T. belizensis* sometimes hirsutulous)....*aa.*

aa. Calyx-lobes linear-lanceolate to lanceolate; leaflets 5–19, the upper pairs lanceolate or ovate-lanceolate, glabrous and estomatiferous above, strigillose or short-strigose and silky below; bracts deciduous.....33. *T. belizensis*

aa. Calyx-lobes deltoid or deltoid-ovate ....*bb.*

bb. Leaflets (11–)13–25(–29); axis of inflorescence not flattened; bracts often deciduous, 5–12 mm. long; staminal tube 14–15 mm. long; legume 4.5–5 mm. wide.....11. *T. onobrychoides*

bb. Leaflets 5–11; axis of inflorescence usually flattened, 2-edged; primary bracts 3–9 mm. long, persistent; stam-

inal tube 9–10 mm. long; legume 6 mm. wide.....20. *T. tepicana*

w. Calyx 8–12 mm. long, the upper lobes 4.5–7 mm. long....*cc.*

cc. Primary bracts persistent, 7–18 mm. long; leaflets lanceolate to ovate-lanceolate, elliptic-lanceolate or oblong-lanceolate, the apex acuminate or occasionally acute; calyx hirtellous and hirsute or villous with golden or rusty hairs; ovules 6–7; legume 6–7 mm. broad, hirsutulous to hirsute. .....35. *T. Langlassei*

cc. Primary bracts deciduous, 6–11 mm. long....*dd.*

dd. Calyx or pedicels with 1–2 narrow bracteoles; leaflets evenly hirtellous or hirsutulous above, hirsutulous below with cinereous hairs.....32. *T. pogonocalyx*

dd. Calyx and pedicels without bracteoles; leaflets shining, glabrous or strigillose along the midrib above, strigillose to short-strigose below....*ee.*

ee. Leaflets 5–9, narrowly lanceolate, tapering to both ends, or oblanceolate; inflorescences 2–3 cm. long, compact, subcapitate, the nodes crowded; ovules 6–7.....31. *T. vernicosa*

ee. Leaflets (5–)7–13, oblong, oblong-oblanceolate or linear-oblong; inflorescences 6–27 cm. long, slender; ovules 9–10.....37. *T. quercetorum*

1. **Tephrosia multifolia** Rose

Tephrosia multifolia Rose, Contr. U. S. Nat. Herb. **1:** 320. 1895. "Creek bottom, Manzanillo," Colima, Mexico, *E. Palmer 1364*, 2–18 Mar. 1891 (US 208929-Type; GH, NY, UC, US).

Cracca multifolia Rose, Contr. U. S. Nat. Herb. **12:** 270. 1909.

Cracca arcuata Rydb. N. Amer. Fl. **24:** 166. 1923. Maria Madre Island, Tres Marias Islands, Nayarit, Mexico, *E. W. Nelson 4193*, 3–25 May 1897 (US 345936-Type; GH).

Tephrosia arcuata (Rydb.) Standl. Field Mus. Publ. Bot. **4:** 213. 1929.

Cracca Heydeana Rydb. N. Amer. Fl. **24:** 166. 1923. Cerro Redondo, Dept. Santa Rosa, Guatemala, *Heyde & Lux*, Oct. 1893 (J. D. Smith Distrib. No. 6111) (NY-Type; GH, US).

Tephrosia Heydeana (Rydb.) Standl. Jour. Wash. Acad. Sci. **17:** 167. 1927.

Erect, much-branched perennial herb or shrub, 1–2 m. high, from heavy woody roots. Stems petioles, rachises and axes of inflorescences hirsutulous, often densely so, with upwardly directed to recurved, rusty to cinereous hairs, velvety. Leaves spreading, 9–34 cm. long, the petioles (6–)10–28 mm. long, shorter than the lowermost leaflets, the rachis (5–)8.5–27 cm. long; stipules linear, acuminate, 8–18 mm. long, about 1 mm. wide, usually deciduous; leaflets of the principal leaves 15–37, predominantly 21–35, linear-oblong, oblong, oblong-lanceolate or occasionally

elliptic, the base obtuse to rounded, the apex obtuse, rounded or retuse, mucronate, (14–)20–65 mm. long, (4–)6–14 mm. wide, 3–6 times as long as broad, those near the middle of the leaf usually longest, the terminal leaflet often somewhat shorter than the others; leaflets thin, pale below, pubescent on both surfaces, sparsely to densely velvety-hirsutulous above with soft, fine cinereous hairs, moderately hirsutulous to hirsute or strigose below with cinereous or, along the midrib, rusty hairs; petiolules 1.5–2.5 mm. long, densely hirsutulous. Inflorescences terminal and axillary, the latter usually first and best developed, (3–)4–29 cm. long, leafless or very rarely with a single leaf, the peduncle (1.5–)2–9(–12) cm. long; flowering nodes (5–)10–ca. 50; buds 5–7 at a node, ca. 5 flowering, 2 or 3 fruiting. Primary bracts linear, acute or acuminate, 7–10 mm. long, 1 mm. or less wide, 3-veined, usually persistent, although often broken in herbarium-specimens; secondary bracts linear-filiform, ca. 4 mm. long, deciduous. Pedicels slender, 5–8(–9) mm. long, bending somewhat in fruit. Dried flowers (12–)14–17 mm. long. Pedicels and calyces doubly pubescent, hirtellous and sparsely to densely hirsutulous with ascending or spreading rusty hairs. Calyx 3.5–6(–7) mm. long, the upper lobes acuminate, 1–2 mm. long, the lateral and lowermost lance-subulate to narrowly triangular, acuminate, 1.5–4 mm. long and (2–)3–4.5 mm. long, respectively. Corolla apparently white, becoming yellowish or purplish with age and yellow to purple or brown when dry; blade of the banner obovate, oval or suborbicular, 13–15 mm. high, 9.5–13 mm. broad, densely covered with fine silky, pale to rusty hairs on the back, the claw 2–3.5 mm. long; wings 13–17 mm. long, 3–4.5 mm. wide, with a claw 2–3 mm. long; keel 13–17.5 mm. long, shallow, exauriculate, the claw 3–3.5 mm. long. Staminal tube 9–14 mm. long, the vexillary stamen coherent with the tube, free at the base, either flat or with an angular thickening on the upper side near the base. Ovary silky, densely appressed-hirsutulous, 8–10-ovulate. Legume generally with the distal half somewhat upcurved, 4.5–6 cm. long, 4–5 mm. wide, usually drooping, velvety, densely hirsutulous with fine erect or ascending cinereous to tawny hairs; seeds 8–10, brown to gray, variegated with black, (3.2–)3.8–4.8 mm. long, 2–2.6 mm. wide. Somatic chromosomes 22.

Distribution. Primarily at low altitudes (0–1400 m.) from Chihuahua (?) and Sinaloa to Oaxaca and Veracruz to Chiapas, in Mexico, and southward to Panama. Map 1.

Specimens examined. MEXICO. Without locality, *Sessé, Mociño, Castillo & Maldonado 3730* (part), 1787–1795–1804 (F). Chihuahua: Rocky oak slope, Guasaremos, Río Mayo, *Gentry 2463* (A, F, MEXU, MO, UC, US). Sinaloa: Without locality, *Ortega 4859* (US), *Ortega 7170* (CAS, F); steep, moist canyon slope with mixed dominants. pine forest area, 6–7000 ft., Ocurahui, Sierra Surotato, *Gentry 6319* (GH, PH) (for map, see Gentry 1946); Escuinapa, *Ortega 5172* (US); Estero de Escuinapa, *Ortega 6135* (CAS, US); El Habal, Cacalotan, Rosario, *Ortega 1036* (MEXU). Nayarit: Maria Madre, Tres Marias Ids., *Nelson 4193* (GH, PH, US), *Maltby 113* (US), *Solis 28* (MEXU); Arroyo

Honda, Maria Madre, *Mason 1761* (CAS, US); vicinity of Acaponeta, *Rose, Standley & Russell 14227* (GH, NY, US); Acaponeta, *Lamb 521* (GH, MO, NY, DS, US), *M. E. Jones 23021* (F, NY, UC); San Blas and vicinity, *W. G. Wright 1337* (DS, F, GH, MO, UC); Mexcaltitán, Municipalidad Santiago Ixcuintla, *Ortega 6135* (DS, GH, PH, UC). Jalisco: Roadside between Las Palmas and Ixtapa, 100–400 ft., *Nelson 4137* (GH, US); open spaces in woods on steep hill, south of Puerto Vallarta, 50 m., *Mexia 1113* (A, CAS, GH, UC, US). Colima: Manzanillo, *Palmer 1364*, 1891 (GH, NY, UC, US). Michoacán: Woods, Ostula, Dist. Coalcomán, *Hinton 16180* (US). Oaxaca: Jamiltepec, *Conzatti 4400* (NY, US). Veracruz: Low bush in the bed of the Caloboyo near Wartenberg (near Tantoyuca), Huasteca, *Ervendberg 307*, 1858 (GH, K, PH). Chiapas: Escuintla, *Matuda 17* (A, MO, NY, US); Tres Hermanos, *Juzepozuk 1385* (F); outskirts of Mapastepec, *Hernandez X. & Sharp X-175* (GH).

BRITISH HONDURAS. Secondary forest, Temash River, 100 ft., *Schipp 1340* (A, F, GH, MO, NY); Columbia Forest Camp, *Oliphant*, 1929 (F, K, NY).

GUATEMALA. Without locality, *Owen 13* (US). Izabal: Cultivated as fish poison, Jocoló, *Johnson 1187* (US). Jutiapa: Wet thicket near El Molino (Dept. Santa Rosa), 600 m., *Standley 77561* (F); grassy slope between Jutiapa and La Calera, s.e. of Jutiapa, 850 m., *Standley 76062* (F); Jutiapa, *J. R. Johnston 1481*, 1938 (F). Santa Rosa: Cerro Redondo, 4500 ft., *Heyde & Lux*, 1893 (GH, NY, US); Cuajiniquilapa, 2500 ft., *Heyde & Lux*, 1893 (GH, MO, NY, US); Teocinte, 2500 ft., *Heyde & Lux*, 1892 (GH, US); near Los Verdes, *Standley 60403* (F); along road s.e. of Barberena, 1100–1180 m., *Standley 77733* (F); wet thicket, La Joya de Limón, east of Culiapa, 900 m., *Standley 77945* (F); Oratorio, 1200 m., *Standley 60674* (F).

HONDURAS. Pine and oak region, Mont. de la Flor, Tegucigalpa, *C. & W. von Hagen 1236* (NY).

NICARAGUA. Masaya, *C. Baker 196* (CAS, DS, GH, NY, UC), *793* (US), *23* (GH, NY), 692 (US).

EL SALVADOR. Without locality, *Renson 41* (NY, US), *91* (NY, US). Ahuachapán: *Padilla 279* (NY, US). Santa Ana: Dry open hillside, Santa Ana, 655–900 m., *Standley 20432* (US). San Salvador: San Salvador, *Calderón 134* (F); cultivated from seeds from Oriente, Dept. Usulután, *Calderón 8* (F); San Salvador, *Calderón 133* (GH, US), *Velasco*, 1906 (F, US); roadside, San Salvador, 650–850 m., *Standley 19113* (GH, NY, US), *Standley 19646* (GH, US); bank of quebrada, San Salvador, *Standley 20463* (GH, US); brushy slope, San Salvador, *Standley 23148* (US); road from San Martín to Laguna de Ilopango, *Standley 22555* (GH, NY, US). San Vicente: Brushy slope, vicinity of San Vicente, 350–500 m., *Standley 21626* (GH, US).

COSTA RICA. Río Jesus de San Ramón, Alajuela, *Brenes*, 1932 (F); Río Jesús & Picacho del Mondongo de San Ramón, *Brenes*, 1937 (F); "Alto de la Calera," San Ramón, *Brenes 5872*, 1927 (A, F), Jan. 1936 (F),

Jan. 1934 (F); El Paraiso, *Archer 3746* (US); vicinity of Buenos Aires, Puntarenas, *Pittier 3821* (US), *Tonduz 4986* (US); thickets of the Río Ceibo, Buenos Aires, *Tonduz 4985* (US); Ujarras de Buenos Aires, *Pittier 10634* (US); Buenos Aires-Osa, *Valerio 919* (F); thickets at Nicoya, *Tonduz 13557* (GH, US); Surubus, *Biolley 7032* (US); Río Nandayuri-Colonia Carmona (Guauac), 100 m., *Jiminez*, 1912 (US).

PANAMA. Chiriquí: Boquete, Boquete Dist., *Davidson 591* (A, F, US); between Hato del Jobo and Cerro Vaca, 700–1000 m., *Pittier 5419* (GH, NY, US). Canal Zone: Chiva-Chiva Trail, Red Tank to Pueblo Nuevo, *Piper 5125* (US).

The not inconsiderable number of specimens of this species now available for study fails to show any constant characters for the separation of the three species maintained by Rydberg (1923). All of these plants seem instead to belong to a single, somewhat variable species distributed primarily at low altitudes from Sinaloa and perhaps southwestern Chihuahua, in the west, and Veracruz, in the east of Mexico, southward to Panama. The shrubby habit, numerous thin leaflets, predominantly axillary inflorescences, medium-sized flowers, lance-subulate to narrowly triangular, acuminate calyx-lobes with a double indument, and 8–10-seeded, usually drooping pods are characteristic. The variations in flower-size, leaflet-number, etc. cited by Rydberg do not stand up under examination as either specific or varietal characters. In this connection it should be noted that flower- and calyx-size are often variable in this species, the first flowers at a node being somewhat larger than the last. On a single specimen the length of the calyx may vary from 4–5.5 mm. and that of each of the lobes by a full millimeter.

Several more or less peculiar collections indicate the need for more and better specimens and particularly for observations on such items as habit and position of the inflorescences. The Gentry collections from Chihuahua and Sinaloa are aberrant in appearance with a tendency for "paniculate" inflorescences in which a terminal inflorescence bears lateral branches from the axils of bracts. The altitude is also a very suspicious matter at this latitude, since this species occurs primarily at low levels. The racemes and pods of *Palmer 155* (1895) from Acapulco, Guerrero, are unusually long (to 40 cm. and 7 cm., respectively) and the lowermost calyx-lobe tends to be about 1 mm. longer than in most specimens. A similar collection from Acapulco,

Beechey, 1842, is at Kew. The single seed-bearing Panamanian collection, *Piper 5125*, has unusually small seeds, only 3.2 mm. long and 2 mm. wide.

Tephrosia multifolia appears to be widely grown as a fish-poisoning plant in Central America, where it is known as *barbasco*. The plant undoubtedly contains rotenone and related compounds, but confusion has existed between this plant, "*T. toxicaria*" (= *T. Sinapou*) and "*T. Schiedeana*" (= *T. Sinapou*), so that it is impossible to decipher any of the reported analyses or to determine with certainty the identity of the species mentioned in most anthropological works applying to Central America.

2. **Tephrosia foliolosa** (Rydb.) Riley

Cracca foliolosa Rydb. N. Amer. Fl. **24:** 162. 1923. Cerro Colorado, vicinity of Culiacán [east of Culiacán], Sinaloa, Mexico, *T. S. Brandegee*, 3 Nov. 1904 (US 572117-Type; GH, POM, UC).

Tephrosia foliolosa (Rydb.) Riley, Kew Bull. **1923:** 339. 1923.

Slender shrub about 2 m. high, the base and roots unknown, the stems angled. Stems, petioles, rachises, petiolules and axes of the inflorescences strigillose with cinereous hairs. Leaves 7–18 cm. long, ascending or spreading, the petiole 9–22 mm. long, shorter than the lowermost leaflets, the rachis 5–15 cm. long; stipules subulate or linear-setaceous, 8–10 mm. long, about 0.5 mm. wide, apparently deciduous; leaflets of the principal leaves 15–31, oblong to linear-oblong, the base obtuse or somewhat cuneate, the apex obtuse, rounded or emarginate, mucronate, (15–)20–45 mm. long, (3–)5–11 mm. wide, 3.5–6 times as long as broad, thin, pale beneath, thinly but evenly strigillose above, strigillose below with cinereous hairs, the veins conspicuous. Inflorescences terminal and axillary (sometimes 2 from 1 axil), leafless, ascending, 5–20 cm. long, the peduncle 0.5–4.5 cm. long, the flowering nodes 5–20, buttressed below; buds 5–7 at a node, ca. 5 of these flowering, 1–3 fruiting. Primary bracts subulate or subulate-setaceous, 4–8 mm. long, very narrow, deciduous at anthesis; secondary bracts setaceous, 1–2 mm. long, deciduous. Pedicels very slender, 5–7 mm. long, ascending-hirtellous with cinereous hairs. Dried flowers 16–18 mm. long. Calyx about 4.5 mm. long, strigillose with cinereous hairs, the upper lobes subulate, 1.5–2 mm. long, the lateral deltoid at the base, contracted into a subulate tip, 2.5–3 mm. long, the lowermost subulate, 2.5–3 mm. long. Corolla "white tinged with purple" (Brandegee), the banner with a green spot at the base and yellowish to brownish when dry; blade of the banner oval, ca. 15 mm. high, 11–12 mm. broad, silky with fine hairs on the back, the claw 2–2.5 mm. long; wings 15–17 mm. long, 3.5–4.5 mm. wide, auricled at the base on the upper side, the claw ca. 2.5 mm. long; keel shallow, 18–20 mm. long, scarcely or not at all auricled, the claw ca. 3 mm. long. Staminal tube 12–14 mm. long, the vexillary stamen adnate to the sheath, free at the base, with a conspicuous 2-lobed callosity

on the upper side near the base. Ovary strigillose, 8–11-ovulate. Legume slightly sinuate, curved upward near the end, 4.5–6 cm. long, 4–4.5 mm. wide, ascending or spreading, brown, densely hirtellous with cinereous hairs 0.2–0.4 mm. long, appearing hoary, velvety; seeds (3–)8–11, oval to oblong in outline, cylindric to compressed, 3–3.8 mm. long, 1.8–2.4 mm. wide, light brown to gray, variegated with black or brown. Somatic chromosomes 22.

DISTRIBUTION. Central Sinaloa and adjacent Durango, Mexico. Map 1.

SPECIMENS EXAMINED. MEXICO. SINALOA: Bush, 6 ft., Cerro Colorado, vicinity of Culiacán, *Brandegee*, 1904 (GH, POM, UC, US). DURANGO: Slender shrub 2 m. high, rocky grassy slopes in oak forest, 3000 ft., Sierra Tres Picos, *Gentry 5279*, 19 Dec. 1939 (DS, GH, MEXU, MO, NY, UC).

Although this plant is poorly known, it appears to be a distinct species. It is reminiscent in appearance of both *Tephrosia leiocarpa* and *T. multifolia*, but is easily distinguished from the former by the narrow, hirtellous pods and from the latter by the spreading or ascending pods, the leaflet-shape (which is closer to that of *T. leiocarpa*), the short trichomes of a single length on pedicels, calyx and fruit and the presence of both terminal and axillary inflorescences. Most herbarium-specimens of *T. multifolia* show only axillary inflorescences, and even when both types are present the axillary inflorescences are usually first and best developed.

3. **Tephrosia macrantha** Robinson & Greenman ex Pringle

Tephrosia macrantha Robinson & Greenman ex Pringle, Garden & Forest **7:** 153, 173. fig. 32. May 1894. Tequila, Jalisco, Mexico.

Tephrosia macrantha Robinson & Greenman, Proc. Amer. Acad. **29:** 383. June 1894. "Hills," Tequila, Jalisco, Mexico, *C. G. Pringle 4454*, 5 Oct. 1893 (GH-Type; A, MEXU, MO, PH, UC, US).

Cracca macrantha (Robinson & Greenman) Rose, Bot. Gaz. **40:** 103. 1905.

Erect herbaceous perennial or shrub 1–4 m. high, much branched, the branches monopodial, often sulcate, angled to terete. Branches, axes of the inflorescences, petioles and rachises finely hirtellous with recurved or ascending hairs and hirsutulous with ascending to downwardly and outwardly spreading hairs or strigillose and short-strigose with antrorsely directed hairs. Leaves spreading or ascending, the principal leaves 6.5–22 cm. long, the petioles (7–)11–30 mm. long, shorter or longer than the lowermost leaflets, the rachis (4–)5–16 cm. long; stipules linear-acuminate, 10–15 mm. long, 1 mm. or less wide, deciduous or often detached; leaflets of the principal leaves 13–31, linear-elliptic to elliptic or linear-oblong to

oblong-lanceolate, the base obtuse or somewhat cuneate, the apex acute, obtuse, rounded or retuse, short-mucronate; leaflets 15–55 mm. long, 4–12(–14) mm. wide, 2.5–4.5 times as long as broad, the terminal leaflet often somewhat smaller than the lateral; leaflets thin, pale beneath, the veins often conspicuous, thinly to densely strigillose, hirtellous or hirsutulous beneath with cinereous hairs, appearing somewhat canescent, or often rusty along the midrib. Inflorescences terminal and axillary (occasionally 2 from 1 axil), 5–25 cm. long, the peduncles 1.5–4.5 cm. long, the flowering nodes 6–ca. 35, somewhat buttressed below; buds 3–5 at a node, apparently 2 or 3 flowering, 1 or 2 fruiting. Primary bracts linear, gradually acuminate, 6–12 mm. long, 1 mm. or less wide, deciduous at anthesis; secondary bracts linear-setaceous, 3–6 mm. long, deciduous. Pedicels 8–11 mm. long, very slender, ascending in flower. Dried flowers (18–)20–26 mm. long. Calyx campanulate, 6–6.5 mm. long, hirtellous or both strigillose and short-strigose or hirtellous and hirsutulous, the upper lobes acuminate, 1.5–2.5 mm. long, the lateral and lowermost lanceolate, acuminate, to lance-subulate, 4–5 mm. long and 4.5–5.5 mm. long, respectively. Corolla showy, apparently white, becoming lavender, and brown or lavender in dried specimens; banner strongly recurved in flower, finely silky-hirsutulous on the back, the blade oval to suborbicular, with a conspicuous green spot at the base, 20–22 mm. high, 17–19 mm. broad, the slender claw 4–4.5 mm. long; wings oblong, obscurely auricled at the base, 23–27 mm. long, 4–5 mm. wide, the claw 4.5–5 mm. long; keel shallow, exauriculate, 21–26 mm. long, the slender claw 5.5–6 mm. long. Staminal tube 18–22 mm. long, the vexillary stamen with a prominent angular or collar-like callosity near the base, coherent, except at the base, with the tube which bears a prominent knob on the free edge at either side near the base. Ovary densely silky-strigillose with fine rusty or tawny hairs. Mature fruit unknown, the half-ripe legume scimitar-shaped, the proximal portion straight, the distal portion curved upward, 5–6.5 cm. long, 4.5 mm. wide, densely hirtellous with tawny hairs, drooping; seeds 8–10, the mature seeds unknown. Flowering collections from September through November.

Distribution. At altitudes of 400–1400 m. in Jalisco, México, Colima and Guerrero, Mexico. Map 2.

Specimens examined. MEXICO. Jalisco: Hills, Tequila, *Pringle 4554* (A, GH, MO, MEXU, PH, UC, US); barranca of Guadalajara, 4000 ft., *Pringle 11435* (GH, US), *M. E. Jones 27206*, 1930 (NY, UC, US); near Guadalajara, *Rose & Painter 7352* (GH, NY, US); Etzatlán, *Holway 5100* (US), *Rose & Painter 7526* (GH, US). Colima: Tuxpan Canyon, *Orcutt 5316*, 1910 (US). Guerrero: Sierra Madre, 1300 m., *Langlassé 596* (GH, US) (See discussion, *T. major*); oak forest, Sierrita-Palo Solo, Dist. Galeana, 600 m., *Hinton 14999* (GH); trail west of Suriana, Achotla, Sierra Madre del Sur north of Río Balsas, Dist. Aldama, *Mexia 8806* (GH, MO, NY, UC, US); Temixco, 400 m., *Reko 5013* (US); oak forest, San Antonio, Dist. Montes de Oca, *Hinton 11558* (GH). México: Llano, Plaza de Gallos, Dist. Temascaltepec, 1200 m., *Hinton 5172* (A, NY, US); hill, Tenayac, Dist. Temascaltepec, 1380 m., *Hinton 5099* (GH).

The handsome large flowers of this plant are its most outstanding feature; even on herbarium-specimens these usually exceed 20 mm. in length. The slender keel, 21–26 mm. long, with a long claw, the long staminal tube with prominent callosities, the shrubby habit and the numerous thin leaflets are particularly characteristic. Most specimens have retrorse pubescence on stems, petioles and rachises, but this is by no means constant.

Pringle inadvertently described this species in Garden & Forest in May, 1894, in advance of the formal description by Robinson and Greenman in June of the same year. Pringle had, however, noted in the April issue of that journal that "*Tephrosia macrantha* Robinson & Greenman" was one of the new species discovered by him on his Mexican collecting trip of 1893 and that it would be figured and described in a subsequent issue. His brief, informal description, accompanied by an excellent drawing of this plant, constitutes publication of the species, so that the proper citation is *Tephrosia macrantha* Robinson & Greenman ex Pringle. In view of the unusual publication of the name, the Type of the species should be the specimen designated by Robinson and Greenman in their much more complete description.

4. **Tephrosia Sinapou** (Buc'hoz) A. Chev.

Galega frutescens, flore purpurea, foliis sericeis Burm. Plum. Ic. 126. pl. 235. 1750.

Cytisus? 2. P. Browne, Civ. & Nat. Hist. Jamaica, ed. 1. 296. 1756.

Galega Sinapou Buc'hoz, Hist. Univ. Reg. Veg. pl. 994. 1775. Without description; figure and name only, but the figure diagnostic.

Tephrosia Sinapou (Buc'hoz) A. Chev. Compt. Rend. Acad. Sci. Paris **180:** 1522. 1925, as *Singapou.*

Galega sericea Lam. Encyc. **2:** 596. 1786, not Thunb. 1800, Buch-Ham. 1822, nor *Tephrosia sericea* (Thunb.) Pers. 1807, nor *T. sericea* Baker in Oliver, 1871.

Galega toxicaria Sw. Prod. Veg. Ind. Occ. 108. 1788. Diagnosis inconclusive but based on *Galega frutescens*, etc. Burm. and *Cytisus? 2.* Browne, both of which are undoubtedly this species.

Tephrosia toxicaria (Sw.) Pers. Syn. Pl. **2:** 329. 1807.

Cracca toxicaria (Sw.) Kuntze, Rev. Gen. **1:** 175. 1891.

Tephrosia emarginata HBK. Nov. Gen. et Sp. (folio) **6:** 361. Sept. 1824; Op. cit. (quarto) **6:** 461. Sept. 1824. "*Crescit ad ripam Atabapi, prope La Divina Pastora de San Balthasar, (Missiones del Orinoco),*" *Humboldt & Bonpland,* May 1800. This locality is apparently on the Río Atabapo near San Fernando de Atabapo, Colombia-Venezuela boundary between

T. MACRANTHA
2
1
• T. MULTIFOLIA
o T. FOLIOLOSA
o T. CUERNAVACANA
• T. CONZATTII
4
3
T. NICARAGUENSIS
5
T. RHODANTHA
6
• T. SINAPOU
o T. LEIOCARPA

Dept. Vaupes, Colombia, and Terr. Amazonas, Venezuela. (See Sandwith, Kew Bull. **1925:** 295–310. 1925.)

Tephrosia Schiedeana Schlecht. Linnea **12:** 299. 1838. Barranca de Tioselo near Hacienda de la Laguna, near Jalapa, Veracruz, Mexico, *Schiede*, 29 Aug. 1829 (GH, NY).

Cracca Schiedeana (Schlecht.) Standl. Contr. U. S. Nat. Herb. **23:** 474. 1922.

Orobus sericeus Sessé & Moc. La Natureleza II. **1:** app. 118. 1889. New Spain (Mexico). Fragments of *Sessé & Mociño 3736* (F), marked "*Orobus sericeus*, N[obis]," are *T. Sinapou* and *T. multifolia* Rose. The description applies to *T. Sinapou*, although the characters given are not diagnostic.

Erect herbaceous or suffrutescent perennial to 1 m. high; stems prominently sulcate and angled, branching monopodially. Stems, petioles, rachises, petiolules, axis of inflorescence and pedicels densely hirtellous to hirsutulous with rusty or cinereous, often recurved or retrorse hairs, appearing velvety. Leaves (11–)16–35 cm. long, ascending or spreading, the petiole (7–)20–50 mm. long, longer or shorter than the lowermost leaflets, the rachis (8–)12–25 cm. long; stipules linear, acuminate, to linear-setaceous, 10–17 mm. long, 1 mm. or less wide, persistent, but often broken in herbarium-specimens; leaflets of the principal leaves 17–41, narrowly elliptic to linear-oblong or oblong-oblanceolate to linear-lanceolate, mucronate, 2–6 cm. long, (4–)7–18.5 mm. wide, 3.5–6 times as broad, thin, dull, pale beneath, moderately hirtellous to hirsutulous with fine cinereous hairs above, densely hirtellous to hirsutulous with ascending or somewhat appressed cinereous hairs beneath, appearing somewhat silky or dull, the midrib and principal lateral veins sometimes outlined with hairs; petiolules 1–2.5 mm. long. Inflorescences terminal and from the upper axils, the terminal often with 1–7 branches from the axils of bracts, leafless or rarely the terminal inflorescence with a leaf at the lowermost node, (2–)4–30 cm. long, longer or shorter than the leaves, ascending, the peduncle 2–8 cm. long, sulcate, angled, the flowering nodes 5–ca. 25; buds about 6 at a node, 5 of these flowering, 1–3 fruiting. Primary bracts linear-lanceolate, acuminate, 6–8 mm. long, 1–1.5 mm. wide, apparently deciduous soon after anthesis; secondary bracts linear-setaceous, 5–6 mm. long, 0.5 mm. wide, deciduous. Pedicels 5–8 mm. long, ascending, becoming stout in age. Dried flowers 16–22 mm. long. Calyx 5.0–8.5 mm. long, densely hirtellous to strigillose with cinereous or rusty hairs, the upper lobes nearly completely fused, the free portion 1–3.5 mm. long, the lateral lobes oblong to obovate, abruptly and usually obliquely short-acuminate, 2.0–4 mm. long, 1.5–3.5 mm. broad, the lowermost lanceolate-ovate to ovate or obovate, 2.5–5.5 mm. long, 2–4 mm. broad. Corolla white, the base of the banner with a green spot, the wings marked with violet on the upper side near the base; corolla apparently becoming pinkish or purplish in age; blade of the banner suborbicular, 13–15 mm. high and broad, densely silky-strigose with fine hairs on the back, the claw 2.5–4 mm. long; wings 13–19 mm. long, 3.5–4.5 mm. broad, auricled on the upper side near the base, the claw 3–4 mm. long; keel 14–19 mm. long, the claw 4–5 mm. long.

Staminal tube 11–14 mm. long, the vexillary stamen coherent with the tube, free at the base, with a prominent 2-lobed callosity on the upper surface. Ovary densely hirsutulous or short-strigose, silky; ovules 10–13. Legume nearly straight or slightly curved downward, ascending or spreading, (3.5–)4.5–5.5 cm. long, 4–6.5 mm. wide, hirtellous and hirsutulous with rusty or cinereous hairs, these sometimes somewhat appressed and appearing silky; seeds 8–13, oval-reniform to subquadrate in outline, 2.6–4 mm. long, 2.2–2.6 mm. broad, brown, variegated with black. Somatic chromosomes 22.

Distribution. San Luis Potosí and Veracruz, in eastern Mexico, and Jalisco, in western Mexico, to Guatemala and El Salvador; Jamaica, Hispaniola; Colombia to Ecuador and Peru and in Venezuela, the Guianas, Brazil and Bolivia, primarily in the Amazon drainage; often cultivated. Map 6 (North American localities).

Specimens examined. MEXICO. Without locality, *Sessé, Mociño, Castillo & Maldonado 3736*, 1787–1795–1804 (F); *Muller 958* (NY). San Luis Potosí: Barranca, Las Canoas [west of Rascón], *Pringle 5049* (GH). Veracruz: Orizaba, *Muller 1318* (NY); Orizaba, *Botteri 370* (GH); Mt. Orizaba, *Seaton 506* (GH); region of Orizaba, Borrego, *Bourgeau 2797* (GH), *2797b* (GH); rocky slope, north side of Borrego, Orizaba, *Clausen & Cervantes G. 6215* (MEXU); barranca of Tioselo near Hacienda de la Laguna (near Jalapa), *Schiede*, 1829 (GH, NY); Fortín, Zacuapán, *Purpus 7479* (UC); oak forest, Zacuapán, *Purpus 16368* (A, F); dry open brush woods, sunny slopes, Barranca de Tenampa, Zacuapán, *Purpus 1889* (GH, MO, NY, UC, US). Jalisco: Río Blanco, *Palmer 220* (part), 1886 (GH, K, PH, US); Guadalajara, *Palmer 322*, 1886 (GH, NY, PH, US); barranca of Río Blanco near Guadalajara, 4500 ft., *Pringle 11436* (GH, MEXU, US). México: Llano, Luvianos, Dist. Temascaltepec, *Hinton 8114* (GH, US); Volcán, Dist. Temascaltepec, *Hinton 4683* (F, GH, NY, US). Michoacán: Open pine forest above Achuato, Apatzingán, 3200 ft., *Leavenworth & Hoogstraal 1624* (F, GH, MO, NY). Oaxaca: Oaxaca, *Nelson*, 1894 (US).

GUATEMALA. Guatemala: Without locality, *Aguilar 110* (F); near Guatemala, *Hayes 25* (GH, US). Huehuetenango: Rocky slopes above La Libertad, on Cerro Pueblo Viejo, 1900 m., *Steyermark 50991* (F); trail between Democracia and Santa Ana Huista, Sierra de los Cuchumatanes, 800–1000 m., *Steyermark 51312* (F). Sololá: Dry slopes above San Pedro village, 1900–2000 m., *Steyermark 47163* (F).

EL SALVADOR. Inzacatal, vicinity of San Salvador, 650–850 m., *Standley 22395* (US).

DOMINICAN REPUBLIC. In clearing, Las Lagunas, Cordillera Central, Prov. de Azua, 750 m., *Ekman H6356* (US); vicinity of Laguna, Samaná Peninsula, chiefly on the Pilón de Azucar, 100–500 m., *Abbott 267* (US).

JAMAICA. Brandon Hill, 330 m., *Fawcett 8045* (F, NY); Castleton, *Harris* (NY).

COLOMBIA. Without data, *Mutis 1199* (US); Municipio Florencia, Hacienda "Morelia", 225 m., *Plata G. 79* (US). Boyacá: Río Meta, Cubarral, 180 m., *Cuatrecasas 3668* (US). Chocó: Lloró, 50 km. s. e. of Quibdó, at junction of Río Atrato and Río Andagueda, *Archer 2116* (US); Río Pató, affluent of Río Quito, *Archer 2113* (US). Cundinamarca: La mesa, between Giradot and Facatativa, *Bro. Ariste-Joseph A390* (US). Huila: Neiva, *Archer 3349* (US). Magdalena: Open pasture, mts. just east of Manaure, 1700 m., *Haught 4107* (US); northern slope of Sierra Nevada de Santa Marta, *Seifriz 604* (PH). Putumayo: Mocoa, Río Mocoa, 570 m., *Cuatrecasas 11356* (US), *Archer 3409* (US). Valle del Cauca: La Paila, *Holton*, 1853 (GH, PH); Almaguer, *Lehmann 6147* (US); Popayán, *Archer 3382* (US); La Capilla, 1760 m., Popayán, *Arbelaez & Cuatrecasas 6028* (US); La Trojita, Río Calima (region del Chocó), 5–50 m., *Cuatrecasas 16500* (US); Río Palo between Tacueyó and El Palo, 1450–1700 m., *Cuatrecasas 19540* (A, US); Río Garrapatas, west of Andes of Roldanilla, *Lehman 8399* (F, GH, US). Vichada: Ruins of burnt finca, Río Vichada at Masaguaro, 100 m., ca. 30 km. n.e. of San José de Ocuné, *Hermann 11017* (US); El Porvenir, Río Meta, 145 m., *Cuatrecasas 4443* (US).

ECUADOR. Carchi: Cultivated, Maldonado, *Steere 8071* (F). Chimborazo: Tixán, *Rose & Rose 22406* (GH, US). Napo-pastaza: Cultivated in open field, trail Puyo to Canelos, "Chacra" of Sebastián, 1100 ft., *Mexia 6836* (UC). Tungurahua: Humid forest, San Francisco, 10 mi. n.e. of Ambato, 8500 ft., *Tate 567* (US).

PERU. *Ruiz & Pavon 21/3*, 1778–1788; Santa Ana, 900 m., *Cook & Gilbert 1436* (US). Ayacucho: Cultivated, Aina, between Huanta and Río Apurimac, 750–1000 m., *Killip & Smith 23189* (US), *22558* (F, US), *22300* (F, US). Cuzco: *Bues*, 1930 (F); Machu Picchu, 2100 m., *Cook & Gilbert 1018*. Huanuco: Pampayacu, *Kanehira* (F, GH); between Huanuco and Pampayacu, *Kanehira* (A). Junín: Colonia Perené, *Rodriguez*, 1930 (US); cultivated, Río Pinedo, north of La Merced, 700–900 m., *Killip & Smith 23645* (US); brushy slope, La Merced, 4000 ft., *Macbride 5661* (F); cultivated, east of Quimirí Bridge, La Merced, 800–1300 m., *Killip & Smith 23880* (US); cultivated, Río Perené, near Hacienda 3, Colonia Perené, 600 m., *Killip & Smith 25134* (F, US); cultivated, Pichis Trail, Yapas, 1350–1600 m., *Killip & Smith 25489* (F, US); cultivated, Pichis Trail, Eneñas, 1600–1900 m., *Killip & Smith 25719* (F, GH, US), *25731* (US); Puerto Bermudez, 375 m., *Killip & Smith 26608* (US). Loreto: Forest, Mishuyacu, near Iquitos, 100 m., *Klug 720* (US), cultivated, *1011* (F, US); Hacienda of C. W. Perry, Puerto Leguia, *Killip & Smith 27503* (F, US); clearing, Balsapuerto, lower Río Huallaga basin, 150–350 m., *Killip & Smith 28459* (F, US); clearing, Santa Rosa, lower Río Huallaga below Yurimaguas, 135 m., *Killip & Smith 28811* (F, US); clearing, Peña Blanca, on Río Itaya, 110 m., *Killip & Smith 29677* (F, US); lower Río Nanay, *L. Williams 441* (F, US); Palta-Cocha on the upper Río Nanay, *L. Williams 1267* (F); Santa Rosa, lower Río Huallaga, 155–210 m., *L. Williams 4959* (F); Yarina Cocha, 155 m., *Tessmann 5407* (US-photo).

BOLIVIA. La Paz: Polo-Polo near Coroico, 1100 m., *Buchtien 3785* (F, GH, US), *662* (F). Locality illegible, *M. Cardenas 2010* (US).

VENEZUELA. Amazonas: Cultivated, San Carlos, Río Negro, 100 m., *L. Williams 14635* (F, US). Anzoátegui: Río Chive, *Pittier 15054* (US). Bolivar: Cultivated, Mata Negra, south of El Tigre, 100 m., *L. Williams 13389* (F, US). Tachira: Cultivated, but seed brought from Mesa Rica Mts. near by, San Cristobal, *Archer 3200* (US).

BRITISH GUIANA. Cultivated, Bootooba, Demerara River, *Persaud 63* (F); upper Mazaruni River, long. ca. 60° 10′ W., *De La Cruz 2074* (F, GH, US); dry sandhills east of Rockstone, *Gleason 822* (GH, US); Indian clearing, Tumatumari, *Gleason 325* (GH, US), 388 (GH, US); cultivated, Bonisika Landing, Arawau River, Northwest Dist., *Archer 2315* (US); Morawhanna, *Archer 2421* (US); cultivated, Mabaruma Compound, Northwest Dist., *Archer 2247* (US); Pirara, etc., *Schomburgk 267* (US); Waramuri Mission, Moruka River, *De La Cruz 2503* (F, GH, PH, US), *2594* (F, GH, PH, US).

SURINAME. Cultivated, Carolina and vicinity, *Archer, 2883* (US); cultivated, 22 km. south of Paramaribo, *Archer 2880* (US); cultivated, Vredenburg Weg, *Archer 2858* (US); Scotelweg, *Archer 2646* (US, UC); Forest of Zandery, *Samuels 517* (F, GH, US); cultivated, Sandrij Id., *Archer 2768* (US); Paramaribo Botanic Garden, *Fairchild*, 1932 (US).

FRENCH GUIANA. Karouany, *P. Sagot 121*, 1858 (GH).

BRAZIL. Voyage de M. le Dr. *Jobert* au nord du Bresil, 1877–78 (F); Río Juanambu ad confluens Río Buesaquito, 1250 m., *André 2893* (F, GH). Amazonas: Cultivated, Río Branco, Boa Vista, *Ducke 1383* (A, US). Maranhaõ: Cultivated, Ubim, Maracassume River Region, *Froes 1729* (A, F, US). Pará: Cultivated, Tapana, near Pará, *Killip & Smith 30233* (US), *30234* (US); vicinity of Santarem, *Spruce*, Aug. 1850 (GH).

Tephrosia Sinapou is an easily recognized species of Mexico and Central and South America where it is still employed as a fish-poison and insecticide. In pre-Columbian times its culture was presumably widespread in the Caribbean area but the plant is now limited in that region to Hispaniola and Jamaica. The species is distributed from Veracruz, on the east, and Jalisco, on the west of Mexico, southward to Guatemala and El Salvador, but there a gap appears in the range, for the plant apparently skips the remainder of Central America to reappear in Colombia, Venezuela, the Guianas, Brazil, Bolivia, Peru and Ecuador, primarily in the Amazon Basin. The two areas so defined seem to have populations which differ somewhat in the shape and width of the calyx-lobes. On specimens from Central America, the lateral calyx-lobes are oblong to obovate and abruptly and obliquely short-acuminate, while the lowermost lobe is ovate or obovate. In many South American collections there seems to be

a strong tendency toward narrower calyx-lobes, particularly in the eastern part of this area, so that the lateral lobes may be oblong and the acumination less oblique; the lowermost lobe may be lance-ovate or ovate. There are many intermediates between the two types and the problem needs to be studied more carefully to determine the amount of variability in populations throughout the range.

It is conceivable that differences between the Central and South American plants may be due at least in part to selection in cultivation. Throughout much of the range in South America the plant seems to be represented primarily in cultivation and it is likely that it would not persist in many areas without continued care. Ducke (1939, p. 112–113), for example, records specimens from Santarem in Pará and Parintins in Amazonas, Brazil, and notes that this species occurs in abandoned places, probably growing subspontaneously in Amazonia. If the plant has been spread primarily by man in these regions in connection with its use as a fish-poison, as seems likely, it is possible that considerable selection may have taken place.

The species is likely to be confused only with *Tephrosia multifolia* Rose which occurs from Mexico southward to Panama; the two may be distinguished immediately by the calyx-lobes and inflorescences. The oblique contraction of the lateral lobes of the calyx of *T. Sinapou* is usually evident and is not found in *T. multifolia* in which the lobes are lance-subulate to narrowly triangular and evenly acuminate. The inflorescences of *T. multifolia* are primarily axillary (at least on herbarium-specimens) while those of *T. Sinapou* are definitely terminal and from the upper axils.

Unfortunately, the well-established name *Tephrosia toxicaria* (Sw.) Pers., by which this plant has long been known, must be discarded in favor of the combination *Tephrosia Sinapou*, based on *Galega Sinapou* Buc'hoz. The basonym rests solely on a single plate, without description, but quite recognizable as this species (the South American and Caribbean form), including crude dissections of the flower which satisfy the requirements of Art. 44, International Rules of Botanical Nomenclature, ed. 3. There seems to be no way of avoiding this change to the earlier name.

Although "*Tephrosia toxicaria*" has been mentioned frequently in ethnological writings and in connection with studies on rotenone, it is impossible to determine whether the plant in question is *T. Sinapou* or *T. multifolia*, which has been confused taxonomically with this species and which was also known for a period as *T. Schiedeana* (= *T. Sinapou*). Although the rejection of so appropriate a name as *T. toxicaria* is to be lamented, the lapse of this name will perhaps contribute to clarity in preventing future confusion as to which species is intended. The documentation of ethnological, chemical, insecticidal and agricultural researches with specimens of the plants involved would prevent the invalidation, which occurs in a case such as this, of much work of this type. One happy circumstance in this particular instance is that, since *T. multifolia* is not known to occur in South America, reports of *T. toxicaria* from that region may be referred to *T. Sinapou* with reasonable certainty, the only other large species with which this can possibly be confused being the introduced *Tephrosia candida* DC., a very different plant.

5. **Tephrosia leiocarpa** A. Gray

Tephrosia leiocarpa A. Gray, Pl. Wright. **2:** 36. 1853. "On the Sonoita, near Deserted Rancho, Sonora" (probably near the middle of the base of the east side of the Huachuca Mountains, southwestern Cochise County, Arizona), *C. Wright 965*, 15–16 Sept. 1851 (GH-Type; NY, PH, US).

Cracca leiocarpa (A. Gray) Kuntze, Rev. Gen. **1:** 175. 1891.

Tephrosia affinis S. Wats. Proc. Amer. Acad. **21:** 424. 1886. Hacienda San José (about 25 miles south of Batopilas on the Río Batopilas), southwestern Chihuahua, Mexico, *E. Palmer 55*, Sept. 1885 (GH-Type; MEXU, NY, PH, US).

Cracca affinis (S. Wats.) Rose, Contr. U. S. Nat. Herb. **12:** 269. 1909.

Tephrosia viridis M. E. Jones, Contr. West. Bot. **12:** 7. 1908. Guayanopa Canyon, Sierra Madre, 3600 ft., Chihuahua, Mexico, *M. E. Jones*, 24 Sept. 1903 (POM-Type; DS, POM, US).

Cracca calva Rydb. N. Amer. Fl. **24:** 161. 1923. Slopes of the barranca of Guadalajara, Jalisco, Mexico, 4500 ft., *Pringle 9773*, 11 June 1902 (NY-Type; GH, MO, US).

Suffrutescent perennial or low shrub, 3.5–ca. 10 dm. high, from a thick woody root; stem much branched, monopodial, terete or obtusely angled, sulcate; bark of woody portions tan to brown, striate. Stems, petioles, rachises, petiolules, axes of inflorescences, pedicels and calyces strigillose with fine cinereous or golden hairs. Leaves principally 6–15 cm. long, the petiole 7–32 mm. long, longer or shorter than the lowermost leaflets, the lower petioles longer than the upper, the rachis 2.3–7.2 cm. long; stipules linear-setaceous, 4–12 mm. long, 0.5 mm. or less wide, persistent,

brown, erect or ascending; leaflets of the principal leaves 9–23(–27), linear-oblong to oblong-oblanceolate or elliptic, 11–43 mm. long, (3–)4–12 mm. wide, 3–6 times as long as broad, the apex obtuse, rounded or retuse (terminal leaflets), mucronate, bluish-green (when fresh), glabrous above, sparsely to moderately strigillose beneath with fine cinereous hairs, the veins prominent, stramineous or brownish; petiolules slender, 1–3 mm. long. Inflorescences terminating the principal stem or axillary branches, often with 1–7 branches from the axils of bracts so as to appear paniculate, usually leafless (occasionally the lowermost flowers in the axil of a leaf), the branches straight, erect or ascending, often exceeding the leaves, 3–27 cm. long, the peduncle 0.2–9 cm. long; flowering nodes 3–25, the buds 3–6 (–7) at a node, 2–4 flowering and 1 or 2 fruiting. Primary bracts linear-setaceous, 4–9 mm. long, 0.5–0.7 mm. wide, becoming brown, usually deciduous at or soon after anthesis; secondary bracts about 3 mm. long, nearly setaceous, deciduous. Pedicels 4–7 mm. long, ascending. Dried flowers 15–19 mm. long. Calyx 4.5–6 mm. long, the upper lobes subulate, 1–2.5 mm. long, the lateral deltoid, short- or long-acuminate, 2–3.5 mm. long, the lowermost lanceolate, acuminate, 3–5 mm. long. Corolla white, becoming pink and then carmine in age, the banner with a pale green spot at the base and the back brownish or rusty; blade of the banner oval, rarely slightly auricled at the base, 12–17 mm. high, 11–15 mm. broad, finely strigillose on the back, the claw 2.5–3.5 mm. long; wings linear-oblong, or obliquely so, auricled, 14–20 mm. long, 3–5.5 mm. wide, the claw 3–4 mm. long; keel 15–18 mm. long, with or without an auricle at the base, the claw 2.5–4 mm. long. Staminal tube 12–15 mm. long, the vexillary stamen with a conspicuous callosity near the base, coherent with the tube for about 1/3 of its length, free at the base. Ovary glabrous or strigillose along the upper suture. Legume nearly straight, spreading or ascending, (3–)5–6.5 cm. long, 5–6.5 mm. wide, glabrous or with a few fine hairs on the upper suture, narrowed at the base; seeds (3–)9–11, oval to oblong-reniform, brown variegated with black, (2.8–)3.4–4.8 mm. long, 2.6–3 mm. wide. Somatic chromosomes 22. Flowering collections from mid-June (Jalisco) to late July and early September.

DISTRIBUTION. Dry, well-drained slopes in pineland, oak woodland, or open rocky ground, at 1000–1500 m., from southern Arizona to Sonora, western Chihuahua and the region of Guadalajara, Jalisco, Mexico. Map 6.

SPECIMENS EXAMINED. UNITED STATES. ARIZONA. Cochise Co.: Sonoita Valley near Deserted Rancho (probably near the middle of the eastern base of the Huachuca Mts.), *Wright 965* (GH, NY, PH, US). Pima Co.: Dry southern slope near trail to top of Mt. Baboquivari, 5200 ft., *Gould, Darrow & Haskell 2725* (CAS, MO, US); west slope, Baboquivari Mts., 3000–4500 ft., *Gentry 3450* (CAS) Santa Cruz Co.: Patagonia Mts., *Peebles & Harrison 4740* (US); Patagonia Mts., 4500 ft., *Kearney & Peebles 14815* (CAS, UC); Nogales to Ruby, 4700 ft., *Kearney & Peebles 14918* (GH, POM, NY, US); Sonoita Valley, 4600 ft., *Rothrock 685* (F, GH, NY, PH, US).

MEXICO. Sonora: Pineland burned June 1939, Puerto de los Aserraderos, region of Río Bavispe, *White 3008* (GH); oak grasslands, Cañon del Agua Amarga, region of Río Bavispe, *White 3626* (GH) (for map see White 1948); gravelly slope in the Sierra Batuc, 8 mi. n.e. of Mátape on the road to Batuc, 3300 ft., *Wiggins & Rollins 424* (DS, NY); xeric oak slope, Sierra de Alamos, 3500 ft., *Gentry 4894* (DS, GH, MO, NY); Sierra de Alamos, *Rose, Standley & Russell 12816* (NY, US). Chihuahua: Guayanopa Cañon, Sierra Madre, 3600 ft., *M. E. Jones*, 1903 (DS, POM, US); Río Aros, *LeSueur 1348* (F); Río Benito, *LeSueur 695* (F, GH, MO, TEX); Hacienda San José, 25 mi. south of Batopilas, *Palmer 55*, 1885 (GH, MEXU, NY, PH, US); oak slopes and flats, Guasaremos, Río Mayo, *Gentry 2414* (A, F, MO, UC, US). Jalisco: Near Guadalajara, *Rose & Painter 7353* (NY, US); hillsides near Guadalajara, *Pringle 2873* (GH); barranca of Guadalajara, *Rose & Painter 8027* (US), *Rose & Hough 4826* (US), *Pringle 9773* (GH, MO, NY, US), *Pringle 11434* (GH, US); rocky slopes near top of Barranca de los Oblatos (Barranca Grande or Barranca of Guadalajara) below and near road to Los Baños, about 5 mi. north of Guadalajara, *Moore & Wood 4818* (GH, UC, Bailey Hortorium); barranca near Guadalajara, *Pringle 4451* (GH, MEXU, NY, MO, PH, UC, US); Río Blanco, *Palmer 220* (part), 1886 (GH, NY, US), *594*, 1886 (GH, MEXU, MO, NY, PH, US); vicinity of La Venta, Lake Chapala, *Lemmon & Lemmon*, 1905 (UC).

Collections of this species from the region of Guadalajara, Jalisco, have been designated *Cracca calva* Rydb. These plants supposedly differ from typical *Tephrosia leiocarpa* in having "calyx lobes distinctly longer than the tube; wing petals obliquely obovate," rather than "calyx lobes about equalling the tube; wing petals oblong." The calyx-lobes of *C. calva* are noted as subulate, 4 mm. long, the tube 2.5–3 cm. [mm!], while the lobes of *T. leiocarpa* are lanceolate, 3 mm. long, the tube 2.5–3 mm. long. Neither of these characters can be applied with any degree of satisfaction. In all the material I have seen, the wings of the corolla are very nearly identical, exhibiting parallel variations. The ratio of calyx-lobes to tube has proved throughout the genus to be rather inconsistent, so that it has been used as little as possible as a taxonomic character in this study. The present species seems to be no exception, for the calyx-lobes of some specimens from both areas exceed the tube. It should also be noted that the upper, lateral and lowermost lobes are all of different lengths.

Many calyces from the northern area are nearly cylindric, while most of those from Jaliscan material are campanulate. Unfortunately, however, neither the shape of the calyx nor the

length of the calyx-lobes is constant; the ranges of the latter are given below:

	Calyx-length	*Upper lobes*	*Lateral lobes*	*Lowermost lobe*
Arizona, Sonora, Chihuahua	4.5–6 mm.	1–2 mm.	2–3.5 mm.	3–4.5 mm.
Jalisco	5–5.5 mm.	2–2.5 mm.	3 mm.	4–4.5 mm.

These extremes in themselves can hardly be considered significant as distinguishing characteristics, and not enough individual plants are available to determine the differences between the two areas statistically.

The only differences evident in the Jaliscan specimens are tendencies toward slightly longer peduncles of the inflorescences, the occasional occurrence of a leaf at the first node of the inflorescence, slightly longer calyx-lobes than in many northern specimens and a more nearly campanulate calyx. These do not, however, seem to constitute sufficient bases for the retention of *Cracca calva* as a separate entity in spite of the apparent disjunction in the range between Chihuahua and Jalisco.

6. **Tephrosia Conzattii** (Rydb.) Standl.

Cracca Conzattii Rydb. N. Amer. Fl. **24:** 162. 1923. Las Sedas, Dist. Etla, Oaxaca, Mexico, *C. Conzatti 1786*, 19 May 1907 (US 474970-Type; NY).

Tephrosia Conzattii (Rydb.) Standl. Field Mus. Publ. Bot. **11:** 161. 1936.

Slender shrub, apparently reaching 3 m.; stems terete or angled, striate, the bark pale. Stems, axes of inflorescences, petioles, rachises and petiolules densely hirsutulous to short-strigose with fine cinereous or rusty hairs. Leaves 6–20 cm. long, the petioles (3–)7–20 mm. long, most often shorter than the lowermost leaflets, the rachis 4.5–16 cm. long, striate; stipules linear, acuminate, to linear-setaceous, 6–14 mm. long, 1.5 mm. or less wide, persistent; leaflets of the principal leaves 15–35(–37), linear to linear-oblong or occasionally oblong, the base acute or obtuse, the apex acute, obtuse or rounded, cuspidate-mucronate, 12–37 mm. long, 2.5–7 mm. wide, (3–)5–7 times as long as broad, thin, glabrous to moderately short-strigose or strigose above, strigose beneath with cinereous or, along the midrib and margins, rusty hairs. Inflorescences borne singly in the axils of leaves, usually leafless (rarely one node with a leaf), straight, the lowermost first and best developed, ascending, (3–)5–30 cm. long, usually equaling or exceeding the leaves, the peduncle 1.5–8.5 cm. long; flowering nodes 6–25, the nodes somewhat buttressed below, the buds 5–7 at a node, 3–5 of these flowering and 1 or 2 fruiting. Primary bracts linear, acumi-

nate, often persistent in fruit (although often broken in herbarium-specimens), 6–13 mm. long, 1 mm. or less wide; secondary bracts inconspicuous, linear-subulate, deciduous. Pedicels 5–11 mm. long, ascending, slender. Dried flowers 14–16 mm. long. Calyx 4.5–5.5 mm. long, densely short-strigose with tawny or rusty hairs, the upper lobes acuminate, 1.5–2 mm. long, the lateral narrowly deltoid, acuminate, 2.5–3 mm. long, the lowermost subulate-lanceolate, 4 mm. long. Corolla apparently rose, becoming carmine with age, the standard brownish on the back with fine silky hairs, the blade with a green spot at the base within; blade of the banner ovate to obovate, 14 mm. high, 10–11 mm. broad, the claw 2–2.5 mm. long; wings 14 mm. long, ca. 3–4 mm. wide, with a claw 2–2.5 mm. long and a conspicuous auricle; keel shallow, ca. 15 mm. long, the claw ca. 2–3 mm. long. Vexillary stamen coherent with the staminal tube for about 1/3 of its length, free at the base, with or without an angular callosity near the base. Ovary strigillose along the upper suture, sometimes sparsely so along the lower, otherwise glabrous; ovules 9–11. Legume nearly straight or slightly sinuate, the outer half curving slightly upward, 4–6.5 cm. long, 4.5–5.5 mm. wide, spreading, ascending or drooping, with short, scattered hairs along the upper suture, otherwise glabrous; seeds (4–)7-11, oval-reniform, 3.4–3.8 mm. long, 2.2–2.6 mm. wide, brown variegated with black, plump. Somatic chromosomes 22.

Distribution. Oak woods, 1400–2000 m., México, Guerrero and Oaxaca, Mexico. Map 4.

Specimens examined. MEXICO. México: Oak woods, Ypericones, Dist. Temascaltepec, *Hinton 6998*, 19 Nov. 1934 (F, GH, NY, US); barranca, Volcán, Dist. Temascaltepec, 1410 m., *Hinton 1297*, 9 Aug. 1932 (GH, MEXU, NY, US). Guerrero: Steep bluff and open moist slope, open ridge with sparse cover of low second-growth oak on loose granitic-conglomerate soil, summit of mountains n.e. of Chilpancingo on road to Chilapa, 1800–1900 m., *Moore & Wood 4650*, 19 Aug. 1948 (GH, UC, Bailey Hortorium). Oaxaca: Las Sedas, Dist. Etla, 2000 m., *Conzatti 1786*, 19 May 1907 (NY, US), *2520*, 29 Aug. 1909 (F).

The fifteen to thirty-five or thirty-seven narrow leaflets which are never broadest above the middle, the axillary inflorescences, the often persistent, linear bracts and the glabrous pods are characteristic. The species is most likely to be confused with *Tephrosia leiocarpa*, but is probably more closely related to *T. cuernavacana* which it resembles in its axillary inflorescences and glabrous legumes but from which it differs in bracts, leaflets and number of buds at a node of the inflorescence.

Although the leaflets of the Type are strigose above, the upper surfaces may be either glabrous or more or less strigose. The population studied near Chilpancingo, Guerrero, contains both forms, neither of which is associated with ecological differences.

In most specimens from the State of México the upper surfaces are glabrous. One plant of *Hinton 6998* (US), however, bears minute trichomes scattered on the upper surfaces.

7. **Tephrosia cuernavacana** (Rose) Macbr.

Cracca cuernavacana Rose, Contr. U. S. Nat. Herb. **12:** 269. 1909. "Wooded slopes of barranca above Cuernavaca, 6000 feet," Morelos, Mexico, *C. G. Pringle 6327*, 25 June 1896 (US 461989-Type; CAS, GH, MEXU, NY, PH, UC, US).

Tephrosia cuernavacana (Rose) Macbr. Field Mus. Publ. Bot. **4:** 87. 1925.

Erect suffrutescent perennial from a woody crown; stems simple or branched, monopodial, 6–10 dm. high, herbaceous or sometimes woody below. Stems, petioles, rachises and axes of inflorescences sparsely to densely strigillose to short-strigose or hirsutulous with whitish or rusty hairs. Principal leaves 5–13(–15) cm. long, spreading or ascending, the petiole 5–30 mm. long, longer or shorter than the lowermost leaflets, the rachis 4–11 cm. long; stipules linear to lanceolate, acuminate, 7–10(–13) mm. long, 1–2 mm. wide, persistent, green, ascending; leaflets of the principal leaves 13–29, oblong to elliptic-lanceolate, the apex rounded or somewhat truncate, with a slender mucro, the base rounded or obtuse; leaflets 14–32(–35) mm. long, 4–10(–11) mm. wide, 2–4 times as long as broad, thin, glabrous above, pale, thinly to moderately strigillose to strigose beneath with whitish hairs, the veins pale; petiolules 1–3 mm. long, slender. Inflorescences 2–5, terminating leafless axillary branches of either the main or secondary branches (the uppermost inflorescence sometimes apparently terminating the main axis but actually axillary and overtopping it), 3.5–9(–13) cm. long, ascending, usually exceeded by the leaves, the flowering nodes loosely grouped near the end, the peduncle 2–4(–7) cm. long, the flowering nodes 6–12, the lowermost rarely with a short, few-flowered branch in the axil of a bract; buds and flowers 2 at a node. Primary bracts lanceolate to ovate-lanceolate, acuminate, 7–15 mm. long, 2–5 mm. wide, about 7-veined, deciduous before anthesis, green and foliaceous; secondary bracts lanceolate to linear, 5–9 mm. long. Pedicels 4–7 mm. long, ascending, filiform, thickening somewhat in fruit, densely strigillose with brown hairs. Dried flowers 13–16 mm. long. Calyx 4–5 mm. long, densely strigillose to strigose with rusty-brown hairs, the lobes subulate, the upper 1.2–3 mm. long, the lateral 2.5–3.5 mm. long, the lowermost 3–4 mm. long. Corolla apparently white or pink, becoming pink, lavender or purplish, the banner with a green spot at the base of the blade; blade of the banner obovate to orbicular, 13–17 mm. high, 12–14 mm. wide, finely hairy on the back, the claw 2 mm. long; wings oblong, 14–15 mm. long, 3.5–4 mm. wide, slightly falcate with a distinct basal auricle, the claw 3.5–4 mm. long; keel 14–15 mm. long, the claw 2.5–3 mm. long. Staminal tube 9–10 mm. long, the vexillary stamen lightly adnate to the tube, occasionally coming free, flat, not thickened near the base. Ovary hirtellous along both sutures with rusty hairs, the valves

glabrous; ovules about 10. Legume nearly straight, about 4.5 cm. long, 5.5–6.5 mm. wide, spreading or ascending, hirtellous along the sutures or nearly glabrous, the valves glabrous, brown; seeds 4–9, the mature seeds not seen. Fowering collections from late June through August.

Distribution. Well-drained soils in open oak or pine woods, 1200–1900 m., Morelos, Guerrero and Michoacán, Mexico. Map 4.

Specimens examined. MEXICO. Morelos: Wooded slopes of barranca above Cuernavaca, 6000 ft., *Pringle 6327* (CAS, GH, MEXU, NY, PH, UC, US). Guerrero: Oak woods, Carrizeras, Dist. Mina, *Hinton 10485* (F, GH, MO, NY, US). Michoacán: Woods, Puerto Zarzamora, Dist. Coalcomán, *Hinton 15051* (GH, US); open pine forests, rocky cliffs at Las Baranquillas, Apatzingán, 4000 ft., *Leavenworth & Hoogstraal 1789* (F); common in open, well-drained situations near falls 7 mi. s.w. of Uruapan, 6000 ft., *Leavenworth & Hoogstraal 1249* (F, MO); brownish-red clay loam, open pine woods on road from Tancítaro to Apatzingán, Municipalidad Tancítaro, 5000 ft., *Leavenworth 628* (F); steep slope under pines, just above Tacámbaro on highway to Pátzcuaro, 5500 ft., *Moore & Wood 4035* (GH, Bailey Hortorium), *4843* (GH, UC, Bailey Hortorium).

The combination of axillary inflorescences with two flower-buds at a node, lanceolate primary bracts and glabrous pods is quite unique. This species appears to be most closely allied to *Tephrosia Conzattii*.

As another example of the difficulties involved in pubescence-characters in this genus, it is interesting to note that both appressed and spreading pubescence is found on the stems of specimens from a single collection, *Hinton 15051*. Individuals of both types also occurred in the colony observed at Tacámbaro, Michoacán.

8. **Tephrosia leucantha** HBK.

Tephrosia leucantha HBK. Nov. Gen. et Sp. (folio) **6:** 360. pl. 577. Aug. 1824; Op. cit. (quarto) **6:** 460. pl. 577. Sept. 1824. Near Guanajuato, Mexico, ca. 2000 m., *Humboldt & Bonpland*, Sept. 1803.

Cracca leucantha (HBK.) Kuntze, Rev. Gen. **1.** 175. 1891.

Tephrosia leucantha var. *acuta* M. E. Jones, Contr. West. Bot. **12:** 7. 1908. San Diego Canyon, Sierra Madre, Chihuahua, Mexico, 6400 ft., *M. E. Jones*, 16 Sept. 1903 (POM-Type; DS).

Cracca Roseana Rydb. N. Amer. Fl. **24:** 164. 1923. "Hacienda del Ciervo," between San Juan del Río and Cadereyta, Querétaro, Mexico, *Rose, Painter & Rose 9642*, 20 Aug. 1905 (NY-Type; GH, MEXU, US).

Tephrosia Roseana (Rydb.) Standl. Field Mus. Publ. Bot. **11:** 161. 1936.

Erect or somewhat decumbent herbaceous or suffrutescent perennial from a woody crown and thick woody roots up to 1 m. long; stems 3–6 dm. high, simple or with axillary branches up to 2.5 dm. long, these sometimes branching. Stems, petioles, rachises and axes of inflorescences

strigillose to hirsutulous with antrorsely directed white to rusty hairs. Leaves 6–15 cm. long, the petiole 4–25 mm. long, most often shorter than the lowermost leaflets, the rachis 6–11 cm. long; stipules linear, acuminate, 7–12 mm. or less long, 1 mm. or less wide, persistent; leaflets of the principal leaves 13–29, linear-oblong, oblong-lanceolate or oblong, the base rounded, the apex obtuse, mucronate, (9–)12–35 mm. long, (3–)4–10(–13) mm. wide, 3–5(–7) times as long as broad, the terminal leaflet equal to or smaller than the lateral; leaflets thin, dull, almost glabrous or (usually) thinly strigillose to hirsutulous above with whitish hairs, pale beneath and strigillose to hirsutulous, the hairs along the midrib sometimes rusty, the veins pale, the leaflets appearing canescent, often with whitish margins; petiolules slender, 1–2 mm. long, densely strigillose to hirsutulous with fine cinereous or rusty hairs. Inflorescences terminating the principal stems and axillary branches, 2–15 cm. long the peduncle 0.2–5 cm. long, sulcate, angled, the flowering nodes 6–15, crowded at first, the internodes elongating with age, the nodes prominent, buttressed below the pedicels; buds and flowers 2 at a node, the flowers opening from below, apparently both of a pair at the same time. Primary bracts lanceolate, acuminate, the base acute, (5–)6–12 mm. long, 2–4 mm. wide, ca. 7-nerved, usually deciduous at anthesis; secondary bracts 2–9 mm. long, 1 mm. or less wide, linear, acuminate, 3-veined. Pedicels 5–9 mm. long, ascending, slender, thickening in fruit. Dried flowers 13–16 mm. long. Calyx 3.5–5 mm. long, densely strigillose to hirsutulous with brown or rusty hairs, the lobes subulate (the lateral rarely narrowly triangular), the upper often almost completely fused together, 1–2.5 mm. long, the lateral (2–)3–5 mm. long, the lowermost (2–)3.5–6 mm. long. Corolla white, becoming rose-purple or violet, the banner with a greenish spot at the base, the petals brown in most dried specimens; blade of the banner obovate to orbicular, 12–14 mm. high and wide, finely hairy with rusty hairs on the back, the claw 3.5 mm. long; keel 15–16 mm. long, slightly auricled, the claw 2.5–3 mm. long. Staminal tube 12–13 mm. long, the vexillary stamen coherent with the tube for about 1/3 of its length, with a prominent 2–3-lobed callosity on the upper side near the base. Ovary densely strigillose or short-strigose with tawny or rusty hairs. Legume nearly straight, curving slightly upward near the end, 3.5–5.5 cm. long, about 5 mm. wide, spreading or drooping, densely hirsutulous, rarely strigillose, the hairs rusty or tawny, at least along the margins; seeds 7–9, reniform-oblong, brown to gray, variegated with black, 4–4.4 mm. long, 2.8–3.2 mm. broad.

Distribution. Western and southern Chihuahua, western Tamaulipas, Zacatecas, Durango, Jalisco, Guanajuato and Querétaro, Mexico, apparently at 1500–1800 m. northward and 2000–2500 m. southward.

Specimens examined. MEXICO. Chihuahua: Guayanopa Cañon, Sierra Madre, Dist. Madera, 6000 ft., *M. E. Jones*, 1903 (MO); San Diego Cañon, Sierra Madre, Dist. Madera, 6400 ft., *M. E. Jones*, 1903 (DS, POM); Sierra Madre near Colonia Garcia, *Townsend & Barber* 367 (GH, MO, NY, US); 3 mi. south of Rubio, Cusihuiriachic, *Shreve 7985* (F, GH, US); rocky hills near Cusihuiriachic, *Pringle 2006* (MO, NY, PH, UC,

US); Guajochic, *Hartman 554* (GH, PENN, US). Durango: Tejamén, *Palmer 487*, 1906 (F, GH, NY, UC, US). Zacatecas: Zacatecas, 7000 ft., *Kuntze 23410* (NY); Zacatecas, 7000–8000 ft., *Purpus*, Aug. 1903 (UC), rocky slopes, Dec. 1903 (UC); Zacatecas market, *Palmer 745*, 1898 (GH, US). Jalisco: On rocky slopes near Ojuelos, Lagos, 6500 ft., *Shreve 9300* (GH, PH, UC). Guanajuato: Guanajuato, *Dugès* (US); west-facing slope with dense oak woods on shaly soil between Valenciana and Santa Rosa, km. 11–12 on road from Guanajuato to Dolores Hidalgo, 8000 ft., *Moore & Wood 4790*, 29 Aug. 1948 (GH, UC, Bailey Hortorium). Querétaro: Hacienda del Ciervo, *Rose, Painter & Rose 9642*, 20 Aug. 1905 (GH, MEXU, NY, US); Del Ciervo al cerro de la mesa, *Altamirano 1564*, 20 Aug. 1905 (MEXU, US). Tamaulipas: Tula, *Viereck 560*, June 1930 (US).

The specimens included here under *Tephrosia leucantha* are from widely scattered localities and show considerable variation. Those from the Sierra Madre of Chihuahua and the region of Cusihuiriachic are very much alike in appearance and the single flowering collection from this region has somewhat shorter and broader calyx-lobes and shorter bracts than other specimens examined. *Tephrosia leucantha* var. *acuta* M. E. Jones is referred here. Material from southern Chihuahua and Zacatecas is also very uniform, while that from Tejamén, Durango, is different in being very much branched, with the pubescence of the legume tightly appressed. The Jaliscan collection also has appressed pubescence and, in addition, very narrow leaflets only 3–4 mm. wide. The plant from Querétaro described as *Cracca Roseana* Rydb. has appressed pubescence and is not as rusty brown as some other plants, while the calyx-lobes are slightly longer than in most of the more northern examples. This plant differs from specimens from the type-locality of *Tephrosia leucantha* primarily in the denser, more tightly appressed, paler pubescence.

If a recognizable geographical trend is present in this species, it would appear to be toward shorter, broader, less attenuate calyx-lobes and shorter bracts in the northern portion of the range. Additional collections may, therefore, indicate the need for modification of *T. leucantha* in the sense here used. All of these plants, however, share in common the subulate calyx-lobes, lanceolate bracts, vexillary stamen with a thickening near the base and coherent with the staminal tube, terminal and axillary inflorescences with paired buds at each node, antrorse pubescence and tawny- or rusty-haired pods.

A Jones collection from Guayanopa Canyon, Sierra Madre, Chihuahua, 24 September 1903, made at the same time as the Type of *Tephrosia leucantha* var. *acuta*, is intermediate between *T. leucantha* and *T. leiocarpa*, also collected at this locality. It has the shrubby habit of the latter, an intermediate leaflet-shape, minutely strigillose leaflets and stems and strigillose legumes.

9. **Tephrosia Thurberi** (Rydb.) comb. nov.

Cracca Thurberi Rydb. N. Amer. Fl. **24:** 165. 1923. Mububi, Sonora, Mexico, *Thurber*, June 1851 (Distribution No. 410, in part) (NY-Type; MO, NY; GH-probable isotype).

Tephrosia Thurberi A. Gray, MS. in herb.; Rydb. in syn., N. Amer. Fl. **24:** 165. 1923.

Erect perennial herb 5–6 dm. high; stems 1–several from a woody crown, slightly woody at the base, monopodial, mostly simple or with one or several axillary branches. Stems, axes of inflorescences and pedicels doubly pubescent with rusty or pale hairs: both hirtellous with fine, strongly retrorse hairs and hirsutulous with coarser hairs which curve downward and outward; petioles and rachises hirtellous and hirsutulous with either retrorse or antrorse hairs. Principal leaves 10–17(–22) cm. long, the petiole 9–35(–40) mm. long, shorter or longer than the lowermost pair of leaflets, the rachis (4–)6–12.5(–16.5) cm. long; stipules linear, long-acuminate, to subulate, 10–12 mm. or less long, 1 mm. wide, becoming brown, usually persistent; leaflets of the principal leaves 9–31, mostly oblong to linear-oblong or elliptic, the base and apex rounded, rarely acutish, mucronate, 15–38(–43) mm. long, 6–12(–16) mm. wide, 2–3(–4) times as long as broad, hirtellous to hirsutulous above, hirsutulous to hirsute below; petiolules 1–2.5 mm. long, slender, densely hirsutulous. Inflorescences terminal or sometimes 1 (rarely more) axillary, 5–18 cm. long, erect, the flowers densely crowded at first, the internodes elongating during anthesis and in fruit, the flowering portion at anthesis 2–6(–10) cm. long, the flowering nodes usually 10–30, buttressed below; buds and flowers 2 at a node, anthesis proceeding centrifugally. Primary bracts linear to linear-lanceolate, acuminate, 7–13 mm. long, rarely more than 1.2 mm. wide, deciduous; secondary bracts linear-setaceous, 9 mm. or less long, deciduous. Pedicels 7–10(–11) mm. long, ascending, slender in flower, thickening in fruit, often with a setaceous bracteole. Dried flowers 14–18 mm. long. Calyx 5–6 mm. long, both hirtellous and hirsutulous to hirsute with rusty hairs, the lobes subulate, attenuate, with a broad U-shaped sinus between the upper and lateral lobes, the upper lobes 1.5–2 mm. long, the lateral 3–4 mm. long, the lowermost ca. 5 mm. long. Corolla apparently white, becoming lavender or purplish, the base of the blade of the banner with a green spot; blade of the banner oval to obovate or orbicular, 13–16 mm. high, 11–15 mm. broad, the apex retuse, densely silky-hirsutulous with brown hairs on the back, the claw ca. 3 mm. long; wings 14–16 mm. long, with an acute auricle, the claw 4–5 mm. long; keel

14–15 mm. long with a claw 3–3.5 mm. long. Vexillary stamen with a prominent 2-lobed callosity on the upper side near the base. Ovary densely hirsutulous. Legume nearly straight, 3–6 cm. long, 3.5–4.5 mm. wide, spreading, densely hirsutulous with rusty hairs; seeds 5–10, mature seeds not seen. Flowering collections from late May and June (Thurber) but primarily from late July to early September.

Distribution. Oak and pine woods, mostly between 1300 and 1900 m., southern Arizona, northern Sonora, and southwestern Chihuahua. Map 16.

Specimens examined. UNITED STATES. Arizona. Southern Arizona, 1881 (GH). Pima Co.: near Tucson, *Bottimer 306* (US). Pima or Santa Cruz Co.: Santa Rita Mts., 4500 ft., *M. E. Jones*, 1903 (MO), *Pringle*, 1884 (CAS, F, GH, MO, NY, PENN, PH, POM, US). Santa Cruz Co: Sonoita Valley, 6500 ft., *Rothrock 625* (F, GH, PH, US); Patagonia Mts., *Peebles, Harrison & Kearney 5597* (US), *Kearney & Peebles 10190* (UC, US). Cochise Co.: Ruckey Valley, south peaks of Chiricahua Mts., 9–10000 ft., *Lemmon*, 1881 (F); Ft. Huachuca, *Wilcox*, 1893 (NY), 1894 (NY); Huachuca Mts., *Harrison & Kearney 5792* (US), *Holzner 1732* (US); Huachuca Mts., 6000 ft., *M. E. Jones*, 1903 (POM, UC), 5500 ft., 1903 (US); Miller Canyon, Huachuca Mts., *M. E. Jones*, 1929 (CAS, GH, POM); Ramsey Canyon, Huachuca Mts., *M. E. Jones*, 1929 (MO, NY); open hill tops, Ramsey Canyon, Huachuca Mts., *Gooding 751* (NY, US).

MEXICO. Sonora: Mububi, *Thurber 410* (part) (MO, NY); between Fronterus and Mububi, *Thurber 410* (part) (GH); Bubacomori (Babocomari?), *Thurber 1009* (GH, NY); between Barbocomori and Santa Cruz, *Wright 964* (GH, MO, NY, PH, UC, US); Sierra Verde, *Schott*, Aug. 1855 (F, NY, US); Cerro del Capulin, n.w. of Aribabi, loop of the Río Bavispe, 6100 ft., *White 2706* (GH, US); Cañon Internacional, region of the Río Bavispe, *White 3502* (GH); pineland burned over June 1939, Puerto de los Aserraderos, region of the Río Bavispe, *White 3225* (GH, SMU) (For exact locations, see White (1948)). Chihuahua: Mojarachic, *Knobloch 5576* (F); open pine slope, Sierra Charuco, Río Fuerte, *Gentry 2314* (F, GH, MEXU, MO, UC, US) (see Gentry (1942) for map.).

The narrow, linear to linear-lanceolate acuminate primary bracts (rarely more than 1.2 mm. wide) contrast strikingly with the lanceolate acuminate primary bracts (2–3 mm. wide) of *Tephrosia leucantha*, with which this species has been identified. An additional striking character is supplied by the pubescence of the stems, axes of the inflorescences and pedicels, which in *T. Thurberi* are both hirtellous with strongly retrorse hairs and hirsutulous with coarser hairs which curve downward and outward. In *T. leucantha*, however, the same parts are strigillose to hirsutulous with antrorsely directed trichomes. Since the primary bracts of both species are deciduous at anthesis or soon

thereafter, the very different induments make possible the accurate identification of fruiting specimens. The more westerly and northerly range of *T. Thurberi* is also noteworthy.

Rydberg designated as cotypes both flowering and fruiting specimens (NY). The flowering specimen which clearly shows the narrow bracts should stand as the Type. Unfortunately the plants distributed as *Thurber 410* comprise several collections made in May and June, 1851, at Fronterus, Mububi or intermediate localities in Sonora so that some of the specimens bearing this number do not represent the type-collection, although they are this species and are perfectly characteristic.

10. **Tephrosia virginiana** (L.) Pers.

Cicer Astragaloides (forte) *Virginianum*, hirsutie pubescens, floribus amplis, subrubentibus, Pluk. Phytogeogr. pl. 23, fig. 2. 1692; Almagest. 103. 1696.

Vicia foliis pinnatis abruptis Gronov. Fl. Virgin. 83. 1743; ed. 2, 106. 1762.

Cracca virginiana L. Sp. Pl. **2:** 752. 1753, as to syn. Pluk. Almagest. and Herb. L. (GH-photograph of Type: *Galega*, Sheet 4, in Herb. L.)

Galega virginiana L. Syst. Nat. ed. 10. **2:** 1172. 1759, as to name, not plant.

Galega virginica J. F. Gmel. Syst. Nat. 1552 (index). 1791.

Tephrosia virginiana (L.) Pers. Syn. Pl. **2:** 329. 1807.

Tephrosia virginica (L.) Bigel. Fl. Bost. ed. 2. 278. 1824.

Tephrosia holosericea Nutt. Jour. Acad. Phila. **7:** 105. 1834. "In the plains of Arkansas." (PH-specimen marked "*Tephrosia *holosericea* Nutt. Arkansas (T. Nuttall)" and a fragment, apparently part of the same plant, marked "Arkansas, Dr. Pitcher.").

Tephrosia virginiana γ *holosericea* (Nutt.) T. & G. Fl. N. Amer. **1:** 296. 1838.

Cracca virginiana holosericea (Nutt.) Vail, Bull. Torr. Cl. **22:** 27. 1895.

Cracca holosericea (Nutt.) Britt. & Bak. Jour. Bot. **3:** 16. 1900.

Tephrosia virginiana β *glabra* Nutt. ex T. & G. Fl. N. Amer. **1:** 296. 1838. "Georgia, *Nuttall.*"

Cracca latidens Small, Fl. Southeastern U. S. 609, 1331. 1903. Vicinity of Eustis, Lake County, Florida, *G. V. Nash 1072*, 16–30 June 1894 (NY-Type; GH, MO, NY, PH, UC, US).

Tephrosia latidens (Small) Standl. Field Mus. Publ. Bot. **11:** 161. 1936.

Cracca leucosericea Rydb. N. Amer. Fl. **24:** 163. 1923. On the Washita, between Fort Cobb and Fort Arbuckle, *E. Palmer 114*, 1868 (NY-Type; NY, US).

Tephrosia leucosericea (Rydb.) Cory, Rhodora **38:** 406. 1936.

Cracca Mohrii Rydb. N. Amer. Fl. **24:** 163. 1923. Near Eucheeana, Walton County, Florida, *C. Mohr*, June 1880 (US 773335-Type; US).

Erect perennial herb from a branched woody crown and long slender tough woody roots; stems one to several from each branch of the crown, (2–)3–7 dm. high, monopodial, sometimes with weak axillary branches up to 17 cm. long, nearly terete or obtusely angled. Stems, petioles and rachises sparsely to densely strigillose, strigose, hirtellous, hirsute or villous with fine cinereous or whitish hairs. Leaves 5–14 cm. long, ascending, the petioles principally 1–6(–9) mm. long, those of the lower leaves sometimes 9–12 mm. long, shorter than the lowermost leaflets; lower stipules oblanceolate to linear, the upper linear-lanceolate to subulate, 8–11 mm. or less long, becoming brown, often deciduous; leaflets of the principal leaves 9–31 (or in some plants of northern Florida –39), predominantly 15–25, elliptic to linear-oblong, the base and apex rounded to acute, mucronate, 11–31(–33) mm. long, (2–)4–8(–10) mm. wide, 2–7 times as long as broad, the terminal leaflet often smaller than the lateral and somewhat cuneate or retuse; leaflets dull, thin, bluish- to yellowish-green, glabrous or sparsely to densely strigillose to densely hirsutulous above, sparsely to densely strigillose or hirtellous to hirsute below with fine white or cinereous hairs, appearing woolly or silky, the veins often reddish below; petiolules 0.5–1.5 mm. long. Inflorescences terminating the principal axes (or axillary branches sometimes with a few flowers), either very short-peduncled or the lower 1–6 flowering nodes with leaves, the flowering nodes 7–20 or more, often crowded and buttressed below; buds 2(–3) at a node, of these 2 or very rarely 3 flowering and fruiting, anthesis proceeding centrifugally, the inflorescence elongating in fruit. Primary bracts linear-lanceolate, long-acuminate, to subulate, 8–13 mm. long, 0.5–1.7 mm. wide, often with 1 or 2 teeth, deciduous at anthesis; secondary bracts linear-subulate, 4–6 mm. long, deciduous. Pedicels 4–17(–20) mm. long, ascending, slender, thickening in fruit, sometimes bearing 1–3 bracteoles. Dried flowers 14–21 mm. long. Calyx (4–)5–10 mm. long, strigillose to densely strigose or hirtellous to densely hirsute with long soft spreading hairs, the upper lobes lance-subulate to narrowly deltoid, short to long-acuminate, (2–)3–5(–6) mm. long, the lateral lobes ovate to lanceolate, short- to long-acuminate, (3–)4–6.5 mm. long, the lowermost ovate to lanceolate, short- to long-acuminate, (2–)4–7.5 mm. long. Corolla usually bicolored, the banner lemon-yellow to cream-colored without, cream to white within, the wings and keel rose, rarely white, the petals often brown in dried specimens; banner with an abrupt, short claw or the blade tapering into a claw about 3 mm. long, the blade orbicular to broadly ovate, 14–19 mm. high and broad, finely strigillose or hirtellous on the back; wings 15–20 mm. long, auricled, the claw 2–3 mm. long; keel 14–15 mm. long, nearly semi-circular, with or without an auricle, the claw 2–3 mm. long. Vexillary stamen coherent with the staminal tube for about 1/3 of its length, often bent near the base, sometimes broadened and thickened, the staminal tube 10–13 mm. long. Ovary densely strigillose to strigose with fine cinereous hairs; ovules 8–11. Legume straight to slightly downwardly falcate, (2.5–)3.5–5.5 cm. long, (3.5–)4–5.5 mm. wide, horizontal or ascending, stramineous to dark brown, sparsely strigillose to densely strigose or

hirtellous to densely hirsute or villous with long, soft, white or cinereous hairs; seeds 6–11, bean-shaped, oblong to subreniform in outline, 3.2–4.2 mm. long, brown, variegated with black. Somatic chromosomes 22. Flowering collections principally from mid-April through May at the southern edge of the range and from late June through July in the north.

DISTRIBUTION. Well-drained, open, circumneutral to acid, non-calcareous soils in oak or pine woods, on ridges and prairies from Hillsborough County, New Hampshire, south to Hernando, Lake and Orange Counties, Florida, westward to St. Croix County, Wisconsin, Kiowa County, Kansas and Bailey and DeWitt Counties, Texas, United States; also in extreme southern Ontario, Canada. Map 7.

SPECIMENS EXAMINED. Approximately 1000 specimens of this species have been examined. Since *Tephrosia virginiana* cannot be confused with any other species of the genus in the United States, for most part only specimens to indicate the northern and western edges of the range are cited. All of the collections from Florida, Alabama, Mississippi and Louisiana are cited, however, because of the relatively small amount of material from these areas and the consequent desirability of bringing these records together in one place.

CANADA. ONTARIO. Norfolk Co.: Normandale, *Frs. Victorin, Germain & Dominique 46865* (GH); St. Williams, *Frs. Victorin & Germain & E. Jacques 45867* (GH).

UNITED STATES. NEW HAMPSHIRE. Hillsboro Co.: Merrimack, *Batchelder*, 1918 (F); Nashua, *Robinson 778* (GH); Manchester, *Provost*, 1935 (NY). MASSACHUSETTS. Middlesex Co.: Lowell, *Beattie*, 1927 (OKL, POM). Franklin Co.: Sunderland, *Seymour 3421* (DUKE). NEW YORK. Albany Co.: Londonville, *House 21577* (DUKE, GH, NY, US). Broome Co.: Chenang River, Port Crane, *Millspaugh* (F). Seneca Co.: Junius, *Wiegand & Manning 16658* (MO). OHIO. Erie Co.: Oxford, *Moseley*, 1903 (F); Castalia cemetery, *Moseley*, 1896 (US). Lucas Co.: *Pontius & Bartley*, 1934 (US). Wood Co.: Liberty Twp., *Shanks*, 1939 (NY). MICHIGAN. Kent Co.: Grand Rapids, *Shaddick*, 1895 (US), *Rush*, 1935 (NY). Livingston Co.: Hamburg, *Ehlers 6026* (UC); Buck Lake, *Ehlers 1487* (GH). Muskegon Co.: Muskegon, *Anderson*, 1939 (MO). Washtenaw Co.: Pickerel Lake, Dexter Twp., *McVaugh 7579* (GH). WISCONSIN. Portage Co.: Plover, *Schuette*, 1888 (F, US). Rock Co.: Beloit, *Wadmond 16034* (KY). Trempeleau Co.: Trempeleau, *Fassett 4371* (DUKE). MINNESOTA. Without locality, *Holzinger*, 1890 (US). Winona Co.: Winona, *Hasse*, 1882 (NY).

IOWA. Allamakee Co.: 7 mi. south of New Albin, *Hayden 10306* (ISC). Buchanan Co.: Rowley, *Pammell*, 1902 (ISC). Johnson Co.: Iowa City, *Hitchcock*, 1889 (F, KSA); n.w. of Oxford, *Shimek*, 1923 (WVA). Lee Co.: Sec. 28, T67N R5W, *Fults*, 1931 (ISC). Muscatine Co.: Muscatine, *Tolstead*, 1934 (UC). MISSOURI: Jackson Co.: Sheffeld, *Bush 5846A* (GH). Johnson Co.: Warrenburg, *Steyermark 24592* (F, MO). Lewis Co.: LaBelle, *Steyermark 25732* (F). Macon Co.: Elmer, *Steyermark 40556* (MO). Putnam Co.: Livonia and Unionville, *E. J. Palmer 41101*

(MO). Kansas. Barton Co.: *Imler & Rydberg 1304* (KSA). Clay Co.: Clay Center, *C. Weber 146* (KSA). Cloud Co.: *S. Fraser*, 1930 (KSA). Douglas Co.: *Hitchcock*, 1899 (KSA). Ellsworth Co.: Carneiro, *Bondy 390* (FLAS, OKL); Kanopolis, *Becker*, 1896 (KSA). Kiowa Co.: Greensburg, *B. Smyth 2117* (KSA). Pottawatomie Co.: St. George, *Carleton & Reed*, 1893 (KSA). Stafford Co.: near St. John, *Maupin*, 1934 (KSA).

Oklahoma. Beckham Co.: Sayre, *Hart 56* (OKL). Comanche Co.: Ft. Sill, *Clements 11636* (GH); Wichita Mts., *McMurry 690* (OKL). Roger Mills Co.: *J. Engelman 1597* (OKL). Woodward Co.: Mooreland, *M. Rogers 251* (OKL); *Hyde*, 1944 (OKL). Texas. Bailey Co.: Coyote Lake, *Ferris & Duncan 3474* (DS). Callahan Co.: Clyde, *E. J. Palmer 13823* (TENN). Comanche Co.: Comyn (TEX). Dewitt Co.: western part, *Riedel*, 1942 (TEX). Erath Co.: mi. north of Morgan, *Tharp*, 1941 (GH); *L. Gough*, 1921 (TEX). Guadalupe Co.: Sullivan, *E. J. Palmer 11655* (GH); 13 mi. south of Seguin, *Erlanson 108* (GH), *106* (US). Lamb Co.: 8 mi. south of Olton, *Cory 13506* (GH). Lubbock Co.: Lubbock, *Whitehouse*, 1929 (TEX), *Reed 3051* (US). Montague Co.: *Tharp 2897* (TEX, US).

Louisiana. Natchitoches Parish: Natchitoches, *E. J. Palmer 8016* DS, MO, US). Rapides Parish: 25 mi. south of Alexandria, *Erlanson 134* (US); 7 mi. west of Woodworth, *D. & H. Correll 9713* (DUKE). Mississippi. Attala Co.: west of Kosciusko, *C. A. & U. Weatherby 6293* (GH, NY, PENN, US). Clarke Co.: Enterprise, *Tracy 3298* (NY). Forrest Co.: Hattiesburg, *Drushel 8407* (MO). Harrison Co.: *Woodson & Anderson 1580* (MO). Jones Co.: Laurel, *Tracy 3351* (NY). Pearl River Co.: 10 mi. west of Poplarville, *Erlanson 161, 162* (US).

Alabama. Cullman Co.: Cullman, *Sudworth*, 1891 (US). Jackson Co.: Bryant, *Porter*, 1934 (GH); Racoon (Sand) Mt., *Wherry*, 1933 (PENN). Jefferson Co.: Birmingham, *Moore L6* (MO). Lee Co.: Auburn, *Earle & Baker*, 1897 (F, MO, NY, US). Macon Co.: Tuskegee, *Drushel*, 1915 (MO). Marshall Co.: Guntersville, *Howell 815* (US). Mobile Co.: Mobile, *Mohr*, 1892 (US); 18 mi. north of Mobile, *Erlanson 186, 192* (US); 2 mi. north of Citronella, *Erlanson 198* (DUKE). Montgomery Co.: 1 mi. west of Maxwell Field, Montgomery, *Edwards*, 1932 (PENN). Shelby Co.: Calera, *Everts* (PH).

Florida. Clay Co.: 3 mi. south of Green Cove Springs, *Wood & Clement 7162* (GH); *Blanton 6330* (US); 0.5 mi. east of Penny Farms *Erlanson 273a* (US); Goldhead Branch State Park, *Murrill* (FLAS). Duval Co.: 8 mi. s.w. of Jacksonville, *Kime*, 1943 (FLAS). Gadsden Co.: Chattahoochee, *Knight*, 1942 (FLAS); 2 mi. east of Chatahoochee, *Erlanson 235, 235a* (US). Hernando Co.: *Buswell*, 1928 (MIAMI). Jefferson Co.: Monticello, *Nolan*, 1928 (FLAS). Lake Co.: Eustis, *Hitchcock*, 1894 (FLAS), *Nash 1072* (GH, MO, NY, PH, US). Leon Co.: *Kurz*, 1942 (FLAS). Liberty Co.: near Aspalaga, *Wherry*, 1930 (PENN). Marion Co.: Wiersdale, *West*, 1928 (FLAS); 1 mi. south of Oklawaha, *Erlanson 252* (US). Okaloosa Co.: Choctawatchee Forest, Crestview,

Knight, 1939 (FLAS); 6 mi. north of Ft. Walton, *Erlanson 219* (US), *220a* (GH, US). Orange Co.: 10 mi. n.e. of Orlando, *Blanton 6422* (CAS, DS, GH). Putnam Co.: Putnam Hall, *West & Arnold*, 1942 (FLAS); north of Palatka, *J. Davis*, 1933 (FLAS). Walton Co.: *Morrison*, 1933 (FLAS).

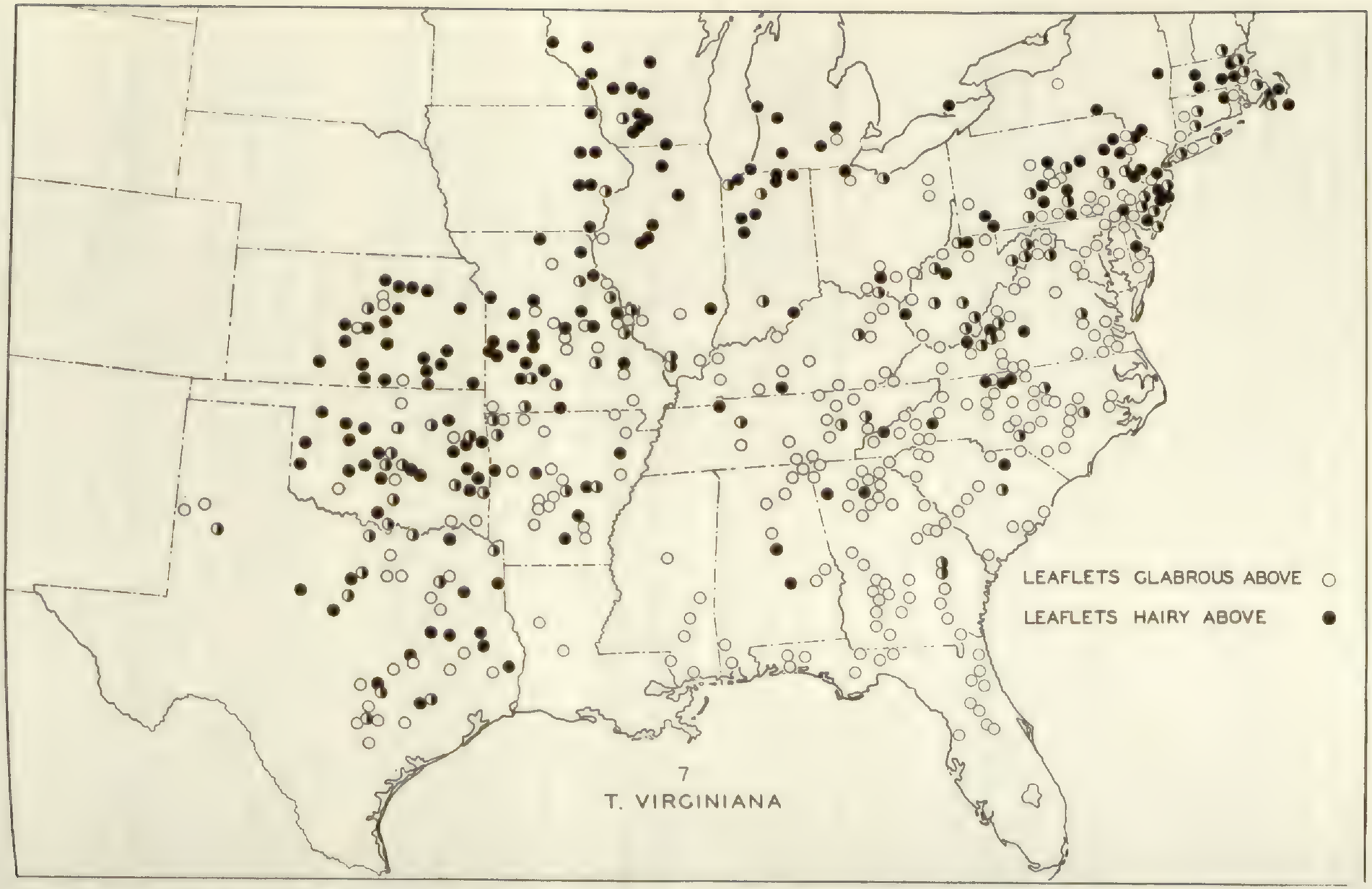
Although *Tephrosia virginiana* is easily distinguishable from the other species occurring in the United States, it is rather variable, particularly with respect to the number and length of the trichomes of the indument, their distribution and appressed or spreading character. A second variable feature is the calyx, the lobes of which are rather inconstant in both shape and length. Since both of these characters, as well as leaflet-shape, have been used as specific and varietal criteria, considerable time has been spent in an attempt to determine what importance may be assigned to these features of the plant.

Almost every possible gradation of hairiness, from few, evenly scattered trichomes to densely crowded trichomes, is encountered within the range of the species. It is quite impossible to delimit any of these phases, other than arbitrarily. No definite segregation of any type can be found. Similarly, the trichomes form a complete series from two-tenths to more than two millimeters long. There appears to be a general tendency for increasing length of hairs from south to north, but many exceptions occur.

In contrast to degrees of pubescence, the presence or absence of hairs on the upper surfaces of the leaflets is usually a clearly defined character. A few intermediates are found but, for the most part, the distinction is rather sharp with the leaflets either glabrous or with various densities of evenly distributed trichomes on the upper surfaces.[1] Both forms very often occur within the same colony and, indeed, are often represented on the same herbarium-sheet. Proportions of "hairy" and "glabrous" plants vary from colony to colony within any given area, seemingly to a large degree by chance. A few mass-collections made in the summers of 1947 and 1948 seem to bear this out.

It will, in addition, be noted from Map 7 that in herbarium-collections there is no real geographic segregation of either type, although more plants with glabrous leaflets are represented in the

[1] This separation into two types may, of course, be arbitrary, since the mode of inheritance of pubescence-characters and the effect of environment are unknown. A whole series of types may be involved, but it appears to be impossible to set up other distinctions at the present time.



Map 7. Distribution of TEPHROSIA VIRGINIANA. Half-filled circles indicate localities or collections from which both glabrous and hairy forms are known. See accompanying text.

southeastern area than elsewhere, while in the northwestern part of the range nearly all of the collections consist of hairy plants. Even though herbarium-specimens probably are not good samples of the populations involved, it seems reasonable on the basis of this material to postulate clines of increasing numbers of hairy

Mass Collections of *Tephrosia virginiana*

Locality	Plants with upper surfaces of leaflets glabrous*		Plants with upper surfaces of leaflets hairy*	
Botetourt Co., Va.	15	(67.5)	7	(32.5)
Roanoke Co., Va.	40	(100)	0	(0)
Montgomery Co., Va.	57	(83.7)	11	(16.1)
Wayne Co., N. C.	22	(95.3)	1	(4.4)
Richmond Co., Ga.	101	(100)	0	(0)
Emanuel Co., Ga.	58	(54)	48	(46)
Roane Co., Tenn.	70	(45.7)	83	(54.3)
Dickson Co., Tenn.	83	(76.2)	26	(23.8)
Prairie Co., Ark.	46	(40.4)	68	(59.6)
Gurdon Co., Ark.	8	(100)	0	(0)
Bowie Co., Tex.	7	(18)	32	(82)

* Figures in parentheses are percentage of either type.

plants from the Southeast, northward and westward, with local variations from one colony to another due to the fixation of either type. There is not, however, sufficient segregation of either glabrous or hairy forms to warrant taxonomic recognition of either entity on a geographical basis.

As in *Tephrosia onobrychoides*, *T. hispidula* and *T. florida*, the hairs on the leaflets may be either spreading or appressed. In this species, however, the distinction is often difficult to make with any degree of certainty although in the above-mentioned species the differences are very conspicuous. There are in *Tephrosia virginiana*, in addition, indications of an ecological influence, as well as that of the plant-press. On a single plant, the lower parts, which presumably develop during the cooler days of the growing season, often show spreading pubescence, while the upper portions bear distinctly appressed hairs. This is particularly evident in the more inland collections. In general, the northern specimens bear spreading pubescence while the southern plants have more appressed hairs. There appears, nevertheless, to be no definite segregation of either type. In the absence of other data it does not seem that much importance can be attached to this feature.

With this discussion as a background, the segregates from *Tephrosia virginiana* are considered below:

The name, *Tephrosia virginiana* var. *glabra* Nutt. ex T. & G., (described as "leaflets nearly glabrous when old"), has been applied to plants with very short and tightly appressed trichomes and to glabrous or glabrate plants (Fernald 1943, p. 452). However, no individuals with the stems, rachises or lower surfaces of the leaflets glabrous are represented in the numerous specimens examined, although many are indeed sparsely strigillose and by late summer the relatively long hairs of some plants may be broken off. This variety has been limited to the southeastern Coastal Plain, where thinly strigillose plants do occur. Plants with longer hairs, however, are also found there, while others which differ only in the greater density of the indument occur in Texas and Oklahoma. There is neither a morphological nor a geographical break.

Tephrosia virginiana var. *holosericea* (Nutt.) T. & G. has been restricted by some authors (Torrey & Gray 1838; Fernald 1943) to specimens in which the leaflets are "very silky pubescent on both sides". Fassett (1939) and Deam (1940), however, concluded that it is quite impossible to determine where the line between this and the typical form should be drawn and have applied this name to plants with the upper surfaces of the leaflets hairy, while restricting the typical form to those with the upper surfaces glabrous. This application seems to be quite justified, although, as pointed out above, there does not seem to be sufficient segregation of either type to warrant retention of this variety.

Tephrosia leucosericea (Rydb.) Cory supposedly is distinguished by the appressed, silky pubescence of leaflets, calyx and legume and by the ovate-lanceolate, short-acuminate calyx-lobes. According to Rydberg the range is from Kansas to Texas. Although some specimens from this region are strikingly silky with tightly appressed hairs, they differ only in degree of pubescence from plants scattered over much of the southern half of the range of *Tephrosia virginiana*, as far north as New Jersey. Plants with appressed pubescence may occur either alone or with individuals with spreading pubescence. Although the original description indicated that the upper surfaces of the leaflets are glabrous or glabrate, the type-sheet also has portions of a hairy plant. The

calyx-lobes are well within the ordinary range of variation exhibited by *Tephrosia virginiana* and are by no means confined to plants with appressed pubescence, nor are they found in all specimens with such pubescence.

Still another segregate, *Cracca latidens* Small, from Lake County, Florida, combines in one plant short, ovate, abruptly acuminate calyx-lobes with leaves bearing as many as 39 broadly oblong leaflets. Unfortunately, these characters appear to have occurred together only at the type-locality. Although the calyx-lobes of these plants are the shortest of any of the specimens seen, the difference is one of degree only, for such calyx-lobes occur sporadically and are neither limited to Florida nor encountered in many Florida plants. There does seem to be a tendency toward an increase in leaflet-number in northern Florida but this, as well as the shape of the leaflets is quite inconstant.

Cracca Mohrii Rydb. is the other combination of oblong leaflets, acute at either end, with "ovate-lanceolate calyx lobes, 2.5 mm. long." The Type is a fruiting specimen with a single shoot bearing a few out-of-season flowers which are smaller than usual and consequently with shorter calyx-lobes. The plant is little more than a freak and deserves no recognition whatsoever.

Tephrosia virginiana seems, therefore, to be a single, widespread, genetically diverse species, lacking in both distinct morphological and geographical variations, although there appears to be a general tendency toward longer and more spreading, somewhat denser pubescence in the northwestern portion of the range and in the opposite direction in the southeastern part.[1] The segregation of specific or varietal entities on any of the grounds discussed above seemingly can be achieved only artificially.

The typification of the species was fully discussed by Britten and Baker (1900), who concluded that the name *Cracca virginiana* L., based on a mixture of two species, was properly applied to

[1] Evidence has been accumulated showing that the variability in the production of rotenone by individuals of this species is genetically controlled (Little 1942). Although large areas lack rotenone-producing plants, the geographical trend in this physiological characteristic is toward greater production of rotenone in the southern portion of the range. The areas of rotenone production are, however, widely scattered (Florida, Georgia, Louisiana, Texas and Oklahoma). (See data and map in Sievers, Russell, et al. 1938, also brief discussion under ECONOMIC IMPORTANCE in the present paper.)

Tephrosia spicata (Walt.) T. & G., while the plant known for 150 years as *Tephrosia virginiana* (L.) Pers. then took the next oldest name, *T. holosericea* Nutt., the basis of the combination, *Cracca holosericea* (Nutt.) Britten & Bak. Robinson subsequently pointed out (Britten & Baker 1900a), however, that since Walter (1788, p. 188) in describing *Galega spicata* had clearly removed the confusing element, while retaining the Linnaean name for the plant figured by Plukenet, there was no cause for the change in typification. Walter has been followed consistently by everyone, including Britten and Baker who, after Robinson's note, recanted. Under the provisions of Article 52, International Rules of Botanical Nomenclature, ed. 3, Walter's restriction of the name is fully justified. In addition, the specimen in the Linnaean Herbarium (*Galega*, Sheet 4), annotated by Linnaeus, is this species as usually understood. Fassett (1939, p. 59) has also discussed the fixation of the Type, and has concluded that the concept of Torrey and Gray in Flora of North America **1**:296. 1838, which is consistent with the Linnaean specimen, had best be retained. The typical form is the common eastern plant with the upper surfaces of the leaves glabrous.

11. **Tephrosia onobrychoides** Nutt.

Tephrosia onobrychoides Nutt. Jour. Acad. Phila. **7:** 104. 1834. "In the plains of Arkansas." (PH—two authentic specimens: the first marked "T. *onobrychoides Nutt. Arkansas. Dr. Pitcher," and the second marked "T. onobrychoides (Nutt.) Arkansas." Both have spreading pubescence: in the second, the upper surfaces of the leaflets are glabrous. The first specimen may be taken as the Type. NY—a specimen marked in Torrey's hand, "Tephrosia pauciflora Nutt. Gen. 'badly described.' Given to me under this name by Nuttall in 1822, but evidently his T. onobrychoides. Arkansas. Nuttall.")

Cracca onobrychoides (Nutt.) Kuntze, Rev. Gen. **1:** 175. 1891, as *onobrycodes*.

Tephrosia multiflora Featherm. Rep. Bot. Surv. South & Cent. La. 73. 1871 in Ann. Rep. Board Supervisors La. State Univ. 1870, not Blatter & Halb. 1918. "Pine barrens of Ponchatoula," Tangipahoa Parish, Louisiana (GH).

Tephrosia angustifolia Featherm. Op. cit. 73. 1871. "Pine barrens near Ponchatoula," Tangipahoa Parish, Louisiana (GH-watercolor of the presumed Type).

Cracca angustifolia (Featherm.) Pennell, Bull. Torr. Cl. **44:** 337. 1917.
Cracca texana Rydb. N. Amer. Fl. **24:** 176. 1923. "Prairies at Hemp-

stead," Waller County, Texas, *Elihu Hall 119*, 1 June 1872 (NY-Type; F, GH, MO, NY, POM, US).

Tephrosia onobrychoides var. *texana* (Rydb.) Macbr. Field Mus. Publ. Bot. **4:** 193. 1929.

Tephrosia texana (Rydb.) Cory, Rhodora **38:** 406. 1936.

Erect or occasionally decumbent perennial herb from a stout, woody crown and woody tap-root; stems stout, terete, to 6 dm. high (exclusive of inflorescence), sometimes 5 mm. in diameter, branching monopodially or sympodially, the branches ascending or decumbent. Stems, petioles, rachises and petiolules strigillose or hirtellous to strigose or hirsute with cinereous to rusty hairs. Principal leaves 8–22 cm. long, the petioles 7–35 mm. long, exceeded by the lowermost leaflets; stipules linear-lanceolate to linear, acuminate, the lowermost 5–17 mm. long, the upper smaller, persistent, becoming brown; leaflets of the principal leaves (11–)13–25 (rarely –29), linear-oblanceolate or narrowly elliptic to oblong-elliptic or elliptic-cuneate, the apex obtuse, rounded or truncate, emarginate, mucronate, 17–55 (–60) mm. long, 4–16(–20) mm. wide, 2.5–6 times as long as broad, thin, dull, glabrous to strigillose or hirtellous to hirsutulous above, strigillose to short-strigose or hirtellous to hirsutulous (or hirsute along the midrib) with cinereous to somewhat rusty hairs below; petiolules 1–2.5 mm. long. Inflorescences terminal or axillary, usually much exceeding the leaves, 1.4–8 dm. long, stout, leafless, terete below, angled above, with 10 to ca. 40 flowering nodes which may be crowded in 2's or 3's; buds 5–6 at a node, 3–5 of these flowering, 1–3 fruiting. Primary bracts linear-lanceolate to linear-setaceous, the lowermost 5–12 mm. long, those above smaller, often deciduous; secondary bracts smaller, 6 mm. or less long, linear-setaceous, deciduous. Pedicels ascending, 4–10 mm. long, filiform in flower, becoming stout in fruit. Calyx 4–5 mm. long, with a double indument, hirtellous and sparsely to densely hirsutulous or hirsute with cinereous or (on the lobes) rusty hairs, the lobes short, deltoid-acuminate, the upper 1–2.5 mm. long, the lateral 2.5–3 mm. long, the lowermost 3–4 (–5) mm. long. Dried flowers 15–20 mm. long. Corolla white becoming crimson in age, pink or purple upon drying; blade of the banner nearly orbicular to ovate, retuse, 12–18 mm. high, 12–16 mm. broad, the claw 3.5 mm. long; wings ca. 19 mm. long, with a small auricle, the claw 4.5 mm. long; keel shallow, 15–17 mm. long, auricled, the claw ca. 4.5 mm. long. Staminal tube generally 14–15 mm. long, the vexillary stamen free only at the base, contracted at the base, flat on the upper surface. Ovary densely strigillose or hirtellous; ovules 10–11. Legume straight or the proximal half slightly curved downward, 3.5–5.8 cm. long, (3.5–)4.5–5 mm. wide, ascending or spreading, strigillose or hirtellous with cinereous hairs; seeds 3–10, narrowly reniform, oblong or subquadrate in outline, the ends flattened through crowding, 3.4–5 mm. long, 2.5–3 mm. wide, mottled with black, smooth. Somatic chromosomes 22.

Distribution. On well-drained, sandy, non-calcareous open soils of the Coastal Plain (see discussion under Distribution and Ecology) from Mobile County, Alabama, to Gonzales and Goliad Counties, Texas, north-

ward to Prairie County, Arkansas, and Muskogee County, Oklahoma, United States. Map 8.

Specimens examined. UNITED STATES. Without definite locality: North America, *Beyrich*, 1834 (MO); Southern States, *Torrey & Gray*, Fl. N. Amer. (GH). Alabama. County uncertain: Portersville, *Mohr*, 1869 (US). Mobile Co.: West Fowl River, *Mohr*, 1867 (DS, MO), 1878, 1897 (NY). Mississippi. Clarke Co.: Enterprise, *Tracy*, 1897 (NY). Arkansas. Without definite locality: *Nuttall* (NY); *Dr. Pitcher* (NY); central and s.w. Arkansas, *Harvey* (KSC). Arkansas Co.: Stuttgart, *Demaree 15414* (KY, NY, TENN). Ashley Co.: Lone Pine Prairie, Mist, 240 ft., *Demaree 18043* (DUKE, GH, KSC, MO, NY, TENN, UC, WVA), *19390* (MO). Bradley Co.: Jersey, *Demaree 19555* (KSC, MO, NY, OKL). Cleveland Co.: Kingsland, *Demaree 19529* (CAS, GH, MO, NY). Drew Co.: *Harvey*, July (GH); Lone Pine Prairie, Ladelle, *Demaree 23369* (GH, MO, NY, TENN, UC); Monticello, *Demaree 17918* (GH, OKL), *23250* (MO, NY, TENN), *17627* (GH, MO, NY, OKL, TENN), *17651* (MO). Garland Co.: Hot Springs, *Scully 384* (GH). Lonoke Co.: Grand Prairie, Carlisle, *Demaree 22339* (MO, PENN). Nevada Co.: Prescott, *Kellogg*, 1910 (MO). Prairie Co.: DeValls Bluff, *Demaree 22177* (GH, MO, NY). Pulaski Co.: Little Rock, *Hasse*, 1885 (NY); Camp Robinson, Little Rock, *Merrill 46* (DUKE). Sebastian Co.: Fort Smith, *Bigelow*, 1853–54 (NY, US); Massard, *Armstrong*, 1940 (TEX). Sevier Co.: *Brinkley 358* (F).

Louisiana. Without data, *Hale* (F, GH, NY); Red River, *Hale* (NY). Acadia Parish: Mermentau, *Degener 5122* (NY). Livingstone Parish: Port Vincent, *Rhoades*, 1931 (GH, KY). Morehouse Parish: Brodnax, *Brodnax*, 1897 (NY). Natchitoches Parish: Chopin, *E. J. Palmer 7637* (DS, MO, PH). Rapides Parish: Alexandria, *Hale* (F); Pineville, *D. & H. Correll 9933* (DUKE, GH, NY); 10 mi. north of Alexandria, *Erlanson 138* (US), 11 mi. north of Alexandria, *143a* (US). St. Tammany Parish: 1.5 mi. north of Abita Springs, *Pennell 4189* (NY, PENN, PH); Covington, *Bro. Arsène 11793* (NY, US), *11509*, *11206*, *11441* (US); Covington, *Bro. Anect 76*, *91* (US); Mandeville to Covington, *Langlois*, *1880* (F). Tangipahoa Parish: 6 mi. east and 1 mi. north of Hammond, *Nease*, 28 May, 7 June 1945 (OKL); Ponchatoula, *Featherman* (GH).

Oklahoma. Indian Territory, *Carleton 67* (KSC); *Butler*, 1877 (MO), 1875 (MO); on the False Washita between Fort Cobb ahd Fort Arbuckle, *Palmer 115*, 1868 (NY, US). Atoka Co.: Atoka, *Sheldon 67* (US); Limestone Gap, *Butler 82* (MO), *102* (PH). Bryan Co.: *Blain 299* (US). McCurtain Co.: Broken Bow, *E. J. Palmer 10483* (MO); SE T6S, R25E, SW T6S, R26E, *Little & Olmsted 337* (OKL). Muscogee Co.: Fort Gibson, *Englemann 1009* (MO); Sec 24, T13N, R18E, *Little 1253* (OKL). Pushmahata Co.: 1.75 mi. s.w. of Albion, *Waterfall 634* (GH, NY, OKL); Antlers, *E. J. Palmer 8319* (GH, MO, PH).

Texas. Without definite locality, *Wright* (GH); from Bexar to Austin, *Berlandier 307* (GH); from Guadalupe River to Colorado River, *Berlandier 1567* (GH). Anderson Co.: 19 mi. s.e. of Athens, *C. & A. Lundell 9610*

(SMU). Angelina Co.: Shawnee Prairie, *Boone*, 1934 (TEX). Austin Co.: 3 mi. north of Sealey, *Erlanson 57* (GH, US); 16 mi. west of San Felipe, *Lindheimer 229* (GH, MO, PH); Belleville, *Erlanson 55* (US). Bastrop Co.: Bastrop, *Tharp 1953* (TEX), *2338* (TEX, US), May 1923 (NY), *Duvay* (TEX), *Strandtmann* (TEX); Bastrop-Buescher State Park, *C. & A. Lundell 8987* (SMU); Elgin, *Whitehouse*, 1929 (TEX); McDade, *Tharp 1953* (US). Bowie Co.: *Eggert*, 1898 (NY). Brazoria Co.: Alvin, *Young 7* (TEX, US); 6.5 mi. west of Alvin, *Cory 11386* (GH). Brazos Co.: *Dana 715* (US). Caldwell Co.: *McBryde*, 1931 (TEX). Cass Co.: Atlanta, *McClung*, 1926 (TEX). Cherokee Co.: Chronister, *White*, 1912 (TEX). Colorado Co.: 1 mi. west of Eagle Lake, *Warnock 46300* (TEX); Columbus, *Tharp 2339* (TEX, US). Dallas Co.: Dallas, *Reverchon 245* (MO, US), *246* (F); southeast of Dallas, *Orr 101* (SMU). Fayette Co.: *Wurzlow*, 1891 (F); Colony, *Crawford 4* (MO), *37*, *43* (US), *47*, *60* (F). Galveston Co.: Kemah, *Fisher*, 1915 (TEX), 1921 (US); San Leon, *Fisher*, 1915 (UC, US). Goliad Co.: Goliad, *C. Williams 19* (PH). Gonzales Co.: *McBryde*, 1931 (TEX). Gregg Co.: *York*, 1939 (GH, TEX), 1941 (GH, SMU, TEX). Hardin Co.: 7 mi. north of Silsbee, *Cory*, 1936 (GH). Harris Co.: Houston, *Lindheimer 32* (GH, MO, UC); Hockley, *Thurrow*, 1890 (F); Houston, *Eifrig*, 13 & 17 July 1926 (F); Houston, *Fisher*, 1918 (CAS, US), 1936 (CAS); Grapeland, *Tharp 81* (NY, US). Jackson Co.: near LaWard, *Drushel*, 1933 (NY). Jefferson Co.: Beaumont, *Hooks*, 1936 (TEX); Port Arthur–Beaumont, *Kilthoff*, 1927 (US). Lee Co.: *Knobloch*, 1931 (TEX). Leon Co.: 10 mi. n.e. of Marques, *Innes & Moon 942* (GH, TEX). Matagorda Co.: Citrusgrove, *F. Johnson*, 1930–1931 (TEX). Montgomery Co.: Willis, *Warm*, 25 May (MO). Nacogdoches Co.: Fern Lake, *Parks RX2326* (MO). Orange Co.: Vidor, *M. Wood*, 1931 (TEX). Polk Co.: Corrigan, *W. Taylor*, 1941 (TEX). Smith Co.: Lindale, *Reverchon 245* (MO). Tarrant Co.: Van Zandt, *Raborn & Reynolds* (TEX). Upshur Co.: 14 mi. west of Gladewater on Highway 90, *Whitehouse 16492* (SMU). Van Zandt Co.: Grand Saline, *Raborn & Reynolds*, 4 June (TEX). Walker Co.: Huntsville, *Tharp*, 1919 (TEX, US). Waller Co.: Hempstead, *Hall 119* (F, GH, MO, NY, POM, US). Victoria Co.: Victoria, *Tharp*, 1923 (TEX, US). Washington Co.: Brenham, *Whitehouse*, 1931 (TEX); *Brackett*, 1938 (TEX). Wood Co.: Golden, *McMullen*, 1927 (TEX); north of Crow, *C. & A. Lundell 9480* (SMU).

Both Pennell and Rydberg employed stature of plant, degree of pubescence and number of leaflets in maintaining *Tephrosia angustifolia* Featherman as a distinct entity. These characters are, however, quite inconstant and there is neither morphological nor geographical isolation. It is likely that the relatively few specimens then available indicated a discontinuity where none exists. The number of specimens available from Louisiana, Mississippi and Alabama is still not large or nearly adequate,

but it is sufficient to show that there is no justification for retaining *Tephrosia angustifolia* as a taxonomic entity of any sort. *Tephrosia multiflora* Featherman, described at the same time from the same locality as *T. angustifolia*, appears to have been merely a slightly larger plant.

The only significant criterion employed by Rydberg in separating his *Cracca texana* from the typical *Cracca* (*Tephrosia*) *onobrychoides* was pubescence, the leaves of the former plant being described as "glabrous or nearly so above, grayish strigose beneath," while those of the latter were "silky pilose both sides or glabrate above." The situation is not quite so simple, for the upper surface of the leaflets of *Tephrosia onobrychoides* (as defined in the present paper) may be glabrous or moderately to densely strigillose, short-strigose or hirsutulous, while the lower surface varies from sparsely strigillose or short-strigose to densely hirsutulous with spreading hairs. If degree of pubescence (including density of distribution and length of hairs) be eliminated as divisible only into arbitrary categories (as seems to be the case both here and elsewhere in the genus), the essential elements are (1) upper surfaces of leaflets glabrous versus hairy and (2) lower surfaces appressed-hairy versus spreading-hairy. These characters are usually well defined with a sharp break between the form with glabrous upper surfaces and that with trichomes evenly distributed over the surface of the leaflets. In plants in which the upper surfaces of the leaflets are hairy, the trichomes are spreading or appressed, corresponding to those on the lower surfaces. As might also be expected, plants with appressed hairs on the leaves have appressed hairs on stems and pods, while those with spreading pubescence have similar pubescence on the stems and bear minute, spreading hairs on the pods.

These two sets of leaf-pubescence characters occur in all four possible combinations within *Tephrosia onobrychoides*. Two or more types are often represented in the same collection and four are represented in *Demaree 18043*, Ashley Co., Arkansas. As is indicated in Map 8, the assembled herbarium-material clearly shows the lack of geographical segregation of any possible combination of pubescence-characters. This is further borne out by the few mass-collections which it has been possible to make. As is shown in the accompanying table and in Map 8, these show

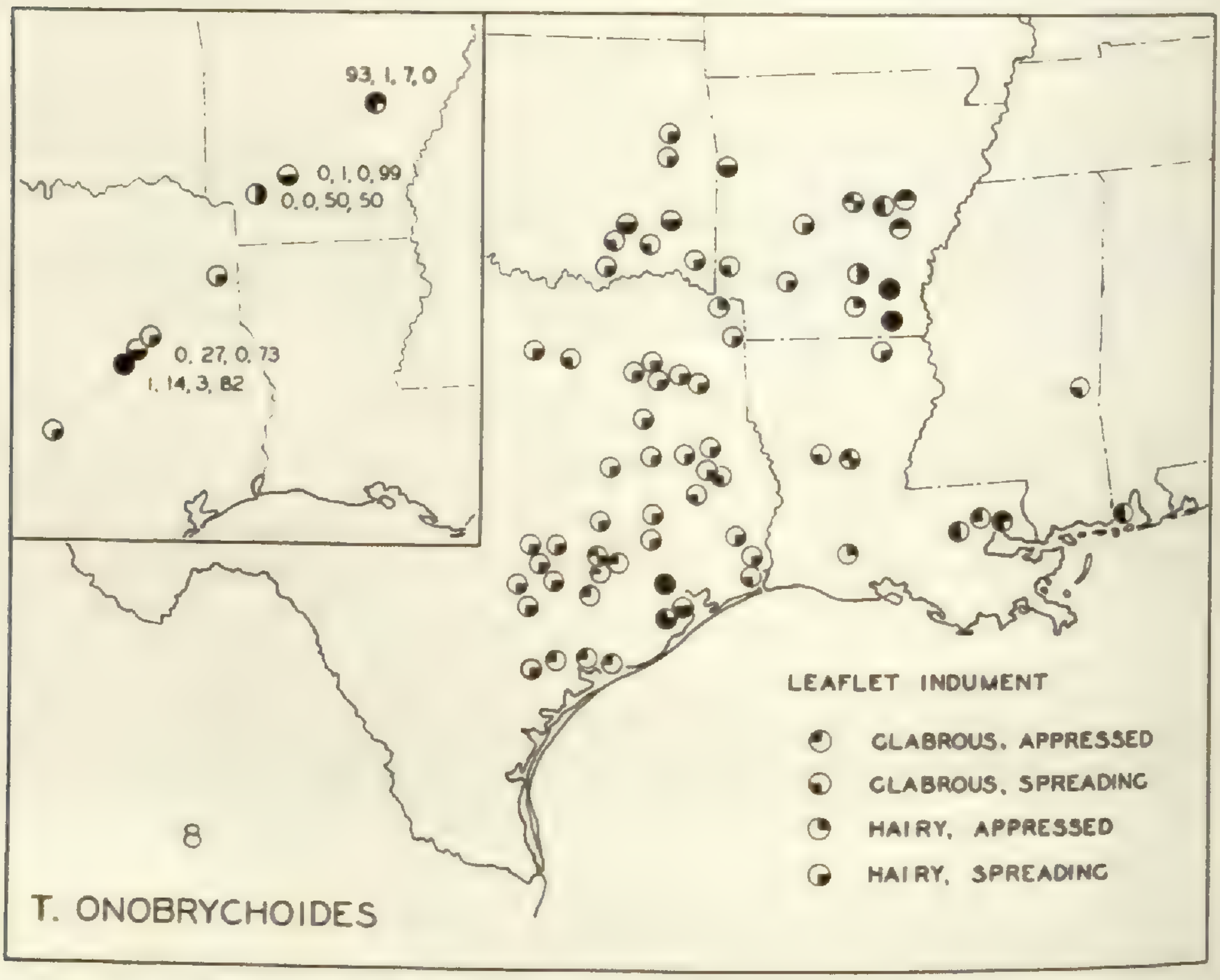
more or less random distribution of these factors from one colony to another, although it is likely that the amount of variability differs from one part of the range to another. Even without the desirable genetic experiments and additional field-work it seems clear that the various pubescence-types merely represent forms unworthy of nomenclatural designation.[1]

Mass-collections of *Tephrosia onobrychoides* to show variation in pubescence. Collections are arranged in sequence from northeast to southwest. (See inset, Map 8.) Figures in parentheses are per cent of total.

Locality	Leaflets glabrous above; appressed beneath	Leaflets glabrous above; spreading beneath	Leaflets pubescent above; hairs appressed	Leaflets pubescent above; hairs spreading	Total
Hazen, Prairie Co., Ark.	102 (92.7)	1 (0.9)	7 (6.3)	——	110
Gurdon, Clark Co., Ark.	——	1 (0.8)	——	127 (99.2)	128
Hope-Sheppard, Hempstead Co., Ark.	——	——	62 (49.6)	63 (50.4)	125
Jefferson, Harrison Co., Tex.	——	——	——	87 (100)	87
Neches, Anderson Co., Tex.	——	——	——	28 (100)	28
Palestine-Oakwood, Anderson Co., Tex.	——	27 (26.7)	——	74 (73.3)	101
Oakwood, Leon Co., Tex.	1 (1)	14 (14)	3 (3)	82 (82)	100
Rockdale, Milam Co., Tex.	——	——	——	43 (100)	43

[1] It should be noted that Map 8 shows only the distribution of the four types of pubescence as represented in herbarium-material and does not necessarily indicate population variability from one area to another. The number of specimens represented by each dot on the map varies from one to about seventeen (as from Drew Co., Ark.), the exact number depending at least in part upon the habits of the individual collectors, some of whom include portions of several plants in a single number while others tear one plant limb from limb and make several specimens of the fragments. Since many plants of *Tephrosia onobrychoides* are too large to fit an herbarium-sheet it is impossible to tell exactly how many individuals are represented. Other factors involved include the paucity of the sample, the question of the randomness of the sample represented by the herbarium-specimens and the relative scarcity of collections from Louisiana, Mississippi and Alabama. As a result of some of these factors, the lack of variability shown along the western part of the range of *Tephrosia onobrychoides* in Texas may well be more apparent than real. Although the populations in this area appear from the herbarium-data to include only plants with both surfaces of the leaflets covered with spreading hairs, the few mass-collections show that there is, in reality, much more variation present and that this may fluctuate greatly between colonies of the same region. It is, however, desirable that abundant mass-collections be made before conclusions be drawn as to the variability of populations in various parts of the range of the species.

A peculiar plant intermediate between *Tephrosia onobrychoides* and *T. florida* is represented by *Seymour & Earle 44*, Ocean Springs, Mississippi, 1 Sept. 1891 (CAS, DUKE, GH, MO). The stems of these specimens apparently were decumbent with petioles longer than the lowermost leaflets; the leaves are mostly 19-foliolate; the axis of the inflorescence is somewhat flattened; the flowering nodes vary from 6 to 13; and the vexillary stamen is connate with the tube, but has a moderately distinct thickening on the upper side near the base.



Map 8. Distribution of Tephrosia onobrychoides. Localities or collections from which two or more pubescence-types are known by herbarium-specimens are indicated by superposition of two or more symbols. A solid dot, for example, indicates the occurrence of all four types at the same locality or in the same collection. For discussion see accompanying text. Inset map indicates mass-collections. Figures accompanying symbols represent the percentage of each of the four pubescence-types in the same order as in the legend.

12. **Tephrosia rhodantha** Brandeg.

Tephrosia rhodantha Brandeg. Zoë **5:** 201. 1904. Cofradia (east of Culiacán), Sinaloa, Mexico, *T. S. Brandegee*, 21 Oct. 1940 (UC-Type; GH, US).

Cracca rhodantha (Brandeg.) Rose, Contr. U. S. Nat. Herb. **12:** 270. 1909.

Erect herbaceous or suffrutescent, occasionally decumbent perennial up to 1 m. tall, from a woody crown and tap-root. Stems, petioles and rachises sparsely to densely hirtellous or hirsutulous or occasionally hirsute with cinereous or rusty hairs sometimes more than 1.5 mm. long, the peduncles of the inflorescences with appressed to spreading hairs. Principal leaves 4.5–13 cm. long, spreading or ascending, the petiole 2–8(–12) mm. long, shorter than the lowermost leaflets, the rachis 3–10 cm. long; stipules linear-lanceolate to linear-subulate, 6–10 mm. long, 1.5 mm. or less wide; leaflets of the principal leaves 11–21, narrowly elliptic to linear-oblong or elliptic, the base cuneate to obtuse, the apex rounded to retuse, mucronate, (10–)15–43 mm. long, (3–)4–10(–14) mm. wide, (3–)4–6 times as long as broad, the lowermost leaflets smallest; leaflets dull, often appearing velvety, sparsely to densely hirtellous with fine hairs above, sparsely to densely hirtellous, hirsutulous, strigillose or strigose with cinereous or rusty hairs beneath; petiolules about 1 mm. long. Inflorescences terminal and axillary, the latter inserted singly and emerging obliquely from the axil, leafless, slender, lax, ascending, 4–45 cm. long, the peduncle 3–19 cm. long; flowering nodes 3–25, rather evenly scattered, the flower-buds ca. 3–5 at a node, 1–4 flowering, 1–3 fruiting. Pedicels 3–7(–9) mm. long, slender, ascending, almost filiform in flower, thickening somewhat in fruit. Dried flowers 12–15 mm. long. Calyx 3.5–6 mm. long, hirtellous and hirsutulous to hirsute with gray or rusty hairs, the lobes subulate-attenuate, the upper 1–3 mm. long, the lateral 2–4 mm. long, the lowermost 2.5–4.5 mm. long. Corolla white with a green spot at the base of the banner, becoming pink and then carmine in age, purple in dried specimens; blade of the banner suborbicular, 11–13 mm. high and broad, finely silky-hairy without, the claw 2.5 mm. long; wings obliquely obovate, 13–15 mm. long, 4–5.5 mm. broad, the claw 2–2.5 mm. long; keel 13–15 mm. long, the claw 2.5–3 mm. long. Staminal tube 11–12 mm. long; vexillary stamen free with a prominent, angular callosity on the upper side near the base. Ovary densely silky-hirtellous; ovules ca. 15. Legume straight to slightly curved upward, tapering into the persistent style-base on the upper side, 4.5–7 cm. long, 3.5–4.5 mm. wide, thinly but evenly hirtellous with antrorsely-directed, cinereous or rusty hairs, 0.2–0.4 mm. long; seeds (8–)12–15, oval-reniform in outline, 2.8–3.4 mm. long, 2–2.5 mm. broad, brown to gray, variegated with black. Somatic chromosomes 22. Flowering collections from August to February.

Distribution. Open rocky ground and pine forests, mostly at low altitudes (0–600–1340 m.), from Sinaloa to Colima, México, Guerrero and Tabasco, in Mexico, and to British Honduras and Guatemala. Map 5.

Specimens examined. MEXICO. Sinaloa: Cofradia, *Brandegee*, 1904 (GH, UC, US); Lodiego, *Palmer 1619*, 1891 (GH, NY, US); Capule, 200 m., *Ortega 6089* (US); rocky arroyo margin, 1000 ft., Quebrada de Ilama, Sierra Tacuichamona, *Gentry 5706* (MO) (for exact locality, see Gentry 1946a). Colima: Alzada, *Orcutt 4677* (DS, F). México:

Tejupilco, Dist. Temascaltepec. 1340 m., *Hinton 1921* (K). Guerrero: Hill, Arcelia-Fraguas, Coyuca, Dist. Mina, *Hinton 6603* (F, GH, K, NY, US); oak forest, Alcaparosa, 560 m., Dist. Galeana, *Hinton 10845* (GH, K); hill, Vallecitos, Dist. Montes de Oca, *Hinton 11403, 11641* (GH); roadside bank on granitic soil above Río Papagayo, km. 376–377 below Tierra Colorada on road to Acapulco, *Moore & Wood 4703* (GH, UC). Tabasco: Estapilla, Tenosique, *Matuda 3517* (GH).

BRITISH HONDURAS. Monkey River, in open pine ridge, *Gentle 3632* (A, MO, NY); small shrub growing in open pine flats, All Pines, alt. 5 ft., *Schipp 685* (A, GH, MO, NY, UC).

GUATEMALA. Izabal: Hilly pine forest near Quiriguá, 72–150 m., *Standley 72269* (F); pine ridge, vicinity of Quiriguá, *Standley 23938* (F).

Tephrosia rhodantha is a clearly marked species but it has been confused both with *Tephrosia multifolia* and **T. littoralis* (= **T. cinerea*). The combination of inflorescences inserted singly in the axils of leaves and emerging obliquely, free vexillary stamen and barbate style are quite distinctive, however. Further important points of divergence are in the slender, hirtellous pod which commonly contains 13 to 15 seeds, in contrast to the above species with 8–10 and 8 or 9–12, respectively, and in the leaflet-number which is 11–21 in *T. rhodantha* and 15–37 (predominantly 21–35) and 5–19 in the other two.

The relationships of *Tephrosia rhodantha*, in spite of its habit and axillary inflorescences, appear to be with the sympodially branched, white-flowered species with a free vexillary stamen. As in those species, the flowers of *T. rhodantha* are white, but become pink and then carmine in age. In fresh flowers (and in most herbarium-material) the vexillary stamen is quite free from the tube, but in an occasional pressed flower it is sometimes difficult to determine this condition with certainty. For this reason the species appears at several places in the artificial key.

13. **Tephrosia cana** Brandeg.

Tephrosia cana Brandeg. Proc. Calif. Acad. II. **3:** 126. 1891. "High Sierras—Sierra de la Laguna and Sierra de San Francisquito," Baja California, Mexico. Rydberg chose Sierra de la Laguna as the type-locality, although no specimens from there are in the Brandegee collections at UC. The Type is better taken as "Sierra de San Francisquito," *T. S. Brandegee*, 20 Oct. 1890 (UC-Type; GH).

Cracca cana (Brandeg.) Rydb. N. Amer. Fl. **24:** 176. 1923.

Cracca californica Rydb. N. Amer. Fl. **24:** 176. 1923. Mesa Verde, Cape District, Baja California, *T. S. Brandegee*, 1889 (NY-Type).

Erect or decumbent herbaceous perennial from a woody crown; roots unknown; stems 6–9 dm. long, often branching sympodially, terete or somewhat sulcate, often purplish. Stems, petioles, rachises, petiolules and axes of inflorescences sparsely to densely strigillose to short-strigose or hirsutulous and pilose with fine white hairs. Leaves 5.5–17.5 cm. long, ascending or spreading, the petioles (3–)8–58 mm. long, longer or shorter than the lowermost leaflet; stipules linear-lanceolate to linear-subulate or narrowly deltoid, 7–12 mm. long, often brown and persistent, reflexed, somewhat rigid; leaflets 7–23, linear-elliptic, oblong-elliptic or elliptic, the apex acute, obtuse or sometimes retuse with a straight or sometimes recurved mucro, 11–34(–40) mm. long, (3–)4–9(–12) mm. wide, veiny, glabrous to densely hirsutulous with ascending white hairs above, moderately to densely hirsutulous with antrorsely directed or nearly erect white hairs below, the leaflets often appearing silky or velvety white; petiolules 1–2.5 mm. long. Inflorescences opposite the leaves or terminal, leafless, usually long-peduncled, erect or ascending, 7–40 cm. long, exceeding the leaves, the flowering nodes 6–19, often congested; buds 4–5 at a node, apparently crowded because of the presence of bracteoles, 1 or 2 fruiting. Primary bracts linear-lanceolate to lanceolate, 7–9 mm. long, often deciduous or broken off; secondary bracts linear-lanceolate to lanceolate, 5 mm. or less long. Bracteoles 2, lanceolate to ovate-lanceolate, acuminate, 5–6 mm. long, borne just below the calyx or on the pedicels or near the base of the pedicels. Pedicels 5–8 mm. long, spreading-hirtellous. Dried flowers 11–15 mm. long. Calyx 6–7.5 mm. long, with the bracteoles and bracts densely hirsutulous with fine, white hairs; calyx-lobes lanceolate to ovate, long- or short-acuminate, the upper 3–4.5 mm. long, the lateral 4–6 mm. long, the lowermost 4–6 mm. long. Corolla apparently white or yellowish, becoming pink, rose or lavender in age; blade of the banner suborbicular to broadly ovate, 14–15 mm. high, 13–16 mm. broad, the claw 2.5–3 mm. long; wings 13–17 mm. long, the claw 3–3.5 mm. long; keel nearly semicircular, 12–17 mm. long, slightly auricled, the claw 3–4 mm. long. Vexillary stamen completely free, with a prominent 2-lobed callosity on the upper side near the base. Legume with the outer half slightly curved upward, 4–7 cm. long, 4–5 mm. broad, hirtellous with ascending or erect hairs; seeds 6–11, oblong to subreniform in outline, 3.8–4.4 mm. long, 2.2–2.8 mm. broad, buff, mottled with olive green and/or black. Somatic chromosomes 22.

Distribution. Rocky, open ground and oak forests, 0–1900 m., Cape Region, Distrito del Sur, Baja California, Mexico. Map 15.

Specimens examined. MEXICO. Baja California: Dist. del Sur: Trail down the Lagunas, west side, *M. E. Jones 27203*, 24 Sept. 1930 (POM); in oak forest on dry, rocky hills north of the meadow on Sierra de la Laguna, 5000 ft., *Hammerly 389*, 14 Oct. 1941 (CAS, DS); grassy opening at edge of pine and oak forest, 1850 m., along trail to El Picacho de la Laguna, east of Todos Santos, *Carter, Alexander & Kellogg 2406*, 26 Dec. 1947 (GH, UC); Cañon San Bernardo, *Brandegee*, 13 Oct. 1893; with *Ficus, Lysiloma, Karwinskya* on crest of narrow decomposed granite ridge,

Arroyo San Bernardo, a few miles east of Rancho San Bernardo, eastern drainage of Sierra de la Victoria, west of Miraflores, 750 m., *Carter 2696*, 9 Apr. 1949 (UC); Saucito, *Brandegee*, 14 Oct. 1893 (GH, NY, POM, UC); Sierra de San Francisquito, *Brandegee 135*, 20 Oct. 1890 (UC, US–30 Oct. 1890) (GH–20 Oct. 1891, prob. this number: part of one specimen appears to be the lower portion of the Type-UC); San José del Cabo, *Brandegee*, 17 Sept. 1890 (UC); in white granite sand with *Cyrtocarpa edulis*, *Bursera microphylla*, *Jatropha* and *Fouquieria* on plateau 9.5 km. north of Santiago, ca. 300 m., *Carter 2711*, 10 Apr. 1949 (UC); granite rocks in canyon, San Bartolo, *Gentry 4366*, 20 Mar. 1939 (DS, MO, UC); rocky hillsides near beach, 11 mi. south of Todos Santos, *Whitehead 882*, 25 Mar. 1935 (DS); 17 mi. south of Todos Santos, *Shreve 7230*, 25 Mar. 1935 (DS, F, GH); Los Barriles, *Gander 9770*, 3 Nov. 1941 (CAS).

Tephrosia cana is distinguished by its 7–23 leaflets, congested inflorescences, rather broad calyx-lobes, densely white calyces and bracts, bracteoles on calyces or pedicels, free vexillary stamen and hirsutulous legumes. Until the spring of 1949 the species appeared to be composed of two groups of specimens, the one of collections made from September through December, the other of three collections made in March, all from the Cape Region of Baja California. The March collections are exceedingly white-hairy, have shorter petioles, slightly fewer leaflets, somewhat larger flowers, slightly broader and more shortly acuminate calyx-lobes and narrower and shorter bracteoles than does typical *Tephrosia cana*, described from an October collection. This apparent seasonal segregation suggested that these very hairy plants might represent either a seasonal phase or another entity. In April, 1949, however, Miss Annetta Carter of the University of California very kindly made several excellent collections of *Tephrosia* during a trip to Baja California. Her material dispels any possibility of seasonal phases, for *Carter 2711* shows within a single colony various combinations of characters which definitely link the two groups and *Carter 2696* is the typical form of the species. It is interesting to note that *Carter 2711* was collected at 300 m., while the very white-hairy "March" specimens are from sea-level and most of the remaining specimens (representing the typical form) are apparently from higher altitudes, up to 1850 m., suggesting altitudinal variation. *Brandegee*, 1890, from San José del Cabo, and possibly collected at a low altitude, is, however, the typical form.

The status of the plant described by Rydberg as *Cracca californica* is much more uncertain. I have seen only 3 collections, each representing a single plant and all from the Cape Region of Baja California:

Mesa Verde, *Brandegee*, 1899 (NY-Type); granitic soil, wash margin, forested hills, San Antonio, *Gentry 4335*, 18 Mar. 1939 (DS); on rocky roadside bank with *Tecoma stans* and *Jatropha*, rolling hills, 5.3 km. n.w. of San Antonio, 300 m., *Carter 2714*, 11 Apr. 1949 (UC).

These three plants are similar to *Tephrosia cana* in habit, leaflet-number and -shape, stipules, vexillary stamen, etc. They differ strikingly, however, in the calyx, which bears only very narrow, linear bracteoles 2 mm. long (type-specimen) or lacks them completely. The calyx-lobes of the first two specimens are narrower than in *T. cana*, while on *Carter 2714* the entire calyx is very similar in shape to that of *T. Palmeri* with no evidence of bracteoles. These plants also differ from *T. cana* in their much less congested inflorescences with fewer buds at a node. *Carter 2714* definitely seems to combine characters of both *T. cana* and *T. Palmeri* and suggests that the possibility of a hybrid origin of these plants should be considered. Miss Carter reports that she found only the one large plant, however, and did not see either *T. cana* or *T. Palmeri* at that locality. Both occur in the Cape region, nevertheless, and future collectors in that area may well watch for additional plants of this type. Pending further evidence these specimens are provisionally placed here with *T. cana*.

It may be of interest to call attention to Brandegee's original description of *Tephrosia cana* in which he noted the diadelphous androecium with the "vexillary stamen free for its whole length, even in the bud." He appears to have been the only American author to notice this conspicuous character which sets off a group of 10 related, white-flowered species.

14. **Tephrosia Palmeri** S. Wats.

Tephrosia Palmeri S. Wats. Proc. Amer. Acad. **24:** 46. 1889. "Side of arroyo in the mountains," near Guaymas, Sonora, Mexico, *E. Palmer 246*, Oct. 1887 (GH-Type; DS, NY, US).

Tephrosia Purisimae Brandeg. Proc. Cal. Acad. II. **2:** 149. 1889. San Gregorio, La Purísima and Cardón Grande, Baja California, Mexico. Material from La Purísima and Cardón Grande not seen; only the specimen from San Gregorio is among Brandegee's collections at UC. In the

absence of other material this should be the Type: *T. S. Brandegee*, 3 Feb. 1889 (UC-Type; GH, PH, US).

Cracca Palmeri (S. Wats.) Rose, Contr. U. S. Nat. Herb. **12:** 270. 1909.

Tephrosia hamata Brandeg; Rydb. N. Amer. Fl. **24:** 177. 1923, in syn. MS. name only, not published by Brandegee.

Cracca hamata Rydb. N. Amer. Fl. **24:** 177. 1923. San José del Cabo, Baja California, Mexico, *T. S. Brandegee*, 1 Oct. 1890 (NY-Type; DS, UC; US-fragment).

Suffrutescent caespitose perennial sometimes 7 dm. high, from a woody crown; stems many, annual, freely branching, partially sympodial, erect or decumbent, flexuous, up to 1 m. long, terete or obtusely angled. Entire plant moderately to densely strigillose or short-strigose with fine white hairs, appearing silky, canescent or hoary, frequently bluish-green. Leaves 2.6–18 cm. long, ascending, the petioles 7–40 mm. long, shorter or longer than the lowermost leaflets, the rachis 1.7–13 cm. long; stipules triangular-lanceolate or subulate, 5 mm. or less long, persistent, brown, rigid or spinescent, usually ascending; leaflets of the principal leaves 5–13 (most often 9), linear, linear-oblong or linear-oblanceolate, the base obtuse or acute, the apex acute, obtuse or retuse, with a straight or recurved mucro; leaflets 9–45 mm. long, (1.7)2–7 mm. wide or the terminal leaflet sometimes 50–75 mm. long, 4–6 mm. wide, moderately to densely strigillose to short-strigose on both surfaces with white hairs, usually appearing hoary or canescent, often bluish green, often somewhat conduplicate along the midrib and upwardly reflexed, the veins pale or brownish beneath; petiolules small, 1–2 mm. long. Inflorescences sometimes opposite the leaves or merely terminal, ascending or erect, 7–45 cm. long, usually greatly exceeding the leaves and leafless; flowering nodes (4–)6–16, the buds 4–5 at a node, 3–4 of these developing, 1–2 fruiting. Primary bracts subulate, rigid, persistent (although often broken in herbarium specimens), 4–5 mm. or less long; secondary bracts linear-setaceous, 4 mm. or less long. Pedicels 4–8(–10) mm. long, ascending. Dried flowers 14–18 mm. long. Calyx 5–7 mm. long, the lobes triangular, acuminate to subulate, the sinuses between usually U-shaped, the upper lobes 2.5–3.5 mm. long, the lateral 3–4 mm. long, the lowermost 3.5–4.5 mm. long. Corolla apparently white or pale yellow, becoming pink or lavender in age; blade of the banner broadly oval or ovate to suborbicular, 12–15 mm. high, ca. 14 mm. wide, finely hairy on the back, the claw 2–2.5 mm. long; wings oblong, 14–18 mm. long, with a basal auricle, the claw 3–4 mm. long; keel 13–17 mm. long, with or without a small basal auricle, the claw 3–4.5 mm. long. Staminal tube 10–14 mm. long, the vexillary stamen completely free, thickened above the base with a rounded or slightly 2-lobed callosity. Ovary densely white-silky, strigillose. Legume nearly straight, cylindrical, beaked by the upcurved style-base, 6.5–7 cm. long, 3–4 mm. in diameter, horizontal or ascending, amber-brown, densely strigillose to short-strigose with white hairs usually less than 0.8 mm. long, or occasionally hirtellous or hirsutulous with ascending hairs; seeds 6–12, oblong, 4.5–5 mm. long, 1.8–2.2 mm. wide, pale brown, mottled with black. Somatic

chromosomes 22. Flowering collections from late September and October and January to mid-May.

DISTRIBUTION. Mountains near Guaymas, Sonora, and sandy and gravelly washes in Baja California, Mexico, from about latitude 28° southward. Map 15.

SPECIMENS EXAMINED. MEXICO. SONORA: Side of arroyo, mountains, Guaymas, *Palmer 246*, 1887 (DS, GH, NY, US). BAJA CALIFORNIA: Arroyos, Santa Gertrudis, 600–700 ft., *Purpus 103* (DS, US); canyon, 10 mi. north of Santa Rosalía on the Gulf Coast, *Reed G629* (DS); in wash 9 mi. from Santa Rosalía on the San Ignacio road, *Ferris 8631* (DS, NY, US); broad gravel wash just north of flying field, Santa Rosalía, *Ferris 8710* (DS, NY, US); Santa Rosalía, *Palmer 198*, 1890 (CAS, GH, US); Carmen Island, *Palmer 847*, 1890 (US); sandy washes, San Nicholas Bay, *I. M. Johnston 3709* (CAS, GH, US); San Gregorio, *Brandegee*, 3 Feb. 1889 (GH, PH, UC, US), 1 Feb. 1889 (GH), 6 Apr. 1889 (UC); San Josef, *Rose 16567* (NY, US); Concepción Bay, *Berry 97* (CAS); among rocks around alkali flat at Coyote Cove, Concepción Bay, *Hammerly 122* (CAS, DS, GH); sandy arroyo margin among crags, Purísima, *Gentry 4221* (DS, GH, MO); mountain east of Loreto, *M. E. Jones 27195* (POM); rocks at cliff base, foothills, Rancho Primera Agua, Sierra de la Giganta, *Gentry 3718* (GH, MO, US); La Paz, *M. E. Jones 24274* (CAS, DS, MO, POM, UC); granitic bluffs near Gulf, north of Las Cruces, 32 km. east of La Paz, *Carter 2570* (UC); San José del Cabo, *Rose 16430* (NY, US), *Purpus 494* (MO, US), *Brandegee*, 1 Oct. 1890 (DS, NY, UC, US), 29 Sept. 1890 (GH), 29 Sept. 1891 (PH); along gravelly wash banks, 15 mi. south of Rancho San Bruno, *Whitehead*, 1935 (DS); gravelly hillside 11 mi. north of Cabo San Lucas, *Whitehead 909* (DS); 5 mi. east of Cabo San Lucas, sea level, *Shreve 5265* (DS, UC); Cabo San Lucas, *Johansen 534* (DS), *Gander 9696* (CAS).

According to Rydberg, the plant he described as *Cracca hamata* differs from *Tephrosia Palmeri* in its linear-oblanceolate leaves with a recurved mucro. There are, however, so many intermediate leaf-shapes and conditions of the mucro that there can be hardly any doubt but that these are only two phases of the same species. In leaflet-number, calyx, fruit and pubescence the two are identical. *Tephrosia Purisimae* Brandegee, another segregate, was separated on the basis of a supposedly different habit, pink flowers and smaller seeds. The cotypes are, however, identical with *Tephrosia Palmeri*. The specimen of the type-collection of *T. Palmeri* (*Palmer 246*, 1887) in UC, with which Brandegee presumably compared his plants is not that species at all, but a fruiting specimen of **T. tenella* A. Gray, a species with glabrous styles. Isotypes in GH and DS are mixtures of *T. Palmeri* and **T. tenella*. The white or ochroleucous flowers of

T. Palmeri normally become pink or lavender in age, as do those of many species, so that this supposed difference is of no consequence. In *T. Palmeri*, as here understood, the leaflet-number, the silvery-white, tightly appressed pubescence, the rigid stipules and the deltoid calyx-lobes are characteristic.

15. **Tephrosia Rugelii** Shuttlew. ex Robinson

Tephrosia Rugelii Shuttlew. ex Robinson, Bot. Gaz. **28:** 197. 1899. *"In pinetis, ad fl. Manate, Florida austr. occ."* (Manatee River, Manatee County, Florida, United States), *Rugel 156*, June 1845 (GH-Type; NY).

Cracca Rugelii (Shuttlew. ex Robinson) Heller, Cat. N. Amer. Pl. ed. 2. 7. 1900.

Erect or decumbent perennial herb from a woody crown and fusiform tap-root up to 6 dm. long and 2.2 cm. wide, often with 1–several fusiform or nearly cylindrical branch-roots from its upper part; stems 1–many, up to 5.5 dm. long, monopodial with numerous axillary branches, some of which may overtop the main axis late in the season, giving the appearance of sympodial branching. Stems, petioles, rachises and petiolules strigillose or hirtellous to short-strigose or hirsutulous with golden or rusty hairs. Leaves 3.5–10 cm. long, nearly sessile or with petioles 0.2–2 cm. long; stipules oblanceolate to linear, acuminate, 8 mm. or less long, persistent, or those of the inflorescence deciduous; leaflets (3–)9–15(–17), obovate to elliptic-cuneate to narrowly cuneate, the apex obtuse, retuse or, on the terminal leaflet, sometimes obcordate, mucronate, the leaflets of a single leaf rather uniform in shape and size or the terminal slightly larger, 10–20 (–22) mm. long (including the petiolule), (3–)4–10(–14) mm. wide, yellowish green, strigillose or hirtellous above with fine cinereous hairs or rarely glabrous, strigillose or hirtellous to short-strigose or hirsutulous below with cinereous hairs, the margins with golden or rusty hairs; petiolules 1–1.5 mm. long. Inflorescences terminal or axillary, up to 15 cm. long with 1–6(–8) flowering nodes, the flowers 2–3 at a node, the lowermost and often one or more additional nodes with leaves; leaves of the inflorescence often reduced upwards, eventually to a single leaflet, a linear bract with parallel stipules, a 3-toothed bract or to a lanceolate or linear, acuminate primary bract 5–8 mm. long. Pedicels 4–12 mm. long, ascending. Dried flowers 12–18 mm. long, fresh flowers to 20 mm. Calyx 5–6 mm. long, strigillose and short-strigose or hirtellous and hirsutulous with rusty hairs, the lobes ovate-lanceolate to lanceolate, acuminate, the upper 2–3 mm. long, the lateral (2.5–)3–5 mm. long, the lowermost 3–6 mm. long, about 1.5 mm. wide. Corolla white (the back of the banner yellowish, faintly veined with red), becoming pink and then carmine with age and purple upon drying; blade of the banner nearly orbicular to subquadrate, 12–16 mm. high, 12–19 mm. broad, silky on the back, the claw 2.5–3 mm. long; wings obovate, 15–18 mm. long, auricled, the claw 2–3 mm. long; keel 12–14 mm. long, 6–7.5 mm. deep, the claw 2.5–3 mm. long. Staminal tube 8–11 mm. long, the vexillary stamen free, distinctly knobbed on the

upper side near the base. Ovary densely strigillose, silky; ovules 10–12. Legume slightly downwardly falcate or straight, 2.5–4 cm. long, 4.5–5.5 mm. wide, horizontal or ascending, hirsutulous or hirtellous with rusty, antrorsely-directed hairs; seeds 10–12, globose to subquadrate in outline and flattened laterally, 2.2–2.6 mm. in diameter, brown to gray, variegated with black. Somatic chromosomes 22. Flowering collections principally from mid-March through early June and sporadically through October.

DISTRIBUTION. Well-drained or dry, open, sandy soil in pinelands, flatwoods, pine and oak barrens, peninsular Florida from St. John, Putnam and Alachua Counties south to Broward and Lee Counties. Map 10.

SPECIMENS EXAMINED. UNITED STATES. FLORIDA: Without definite locality: *Simpson 6672* (GH, US); East Florida, *Reynolds* (US); South Florida, west coast, *Rothrock*, 1887 (PENN); Kipimee Prairie, *Mearnes*, 1901 (US). Alachua Co.: east of Gainesville, *Murrill*, Mar. 1939 (FLAS), Apr. 1939 (DUKE). Brevard Co.?: Okeechobee region, *Fredholm 5933* (GH, NY, US) (probably an error for Broward Co., since Brevard is far from Okeechobee). Broward Co.: Ft. Lauderdale, *Meredith*, 1917 (PH). Charlotte Co.: west of Punta Gorda, *Small, Mosier & DeWinkeler 10915* (FLAS). Hardee Co.: Cattle-range station near Limestone, *Kirk*, 1942 (FLAS). Highlands Co.: south of Frostproof, *Small & DeWinkeler*, 1920 (GH); Avon Park, *J. Davis*, 1933 (FLAS); Istokpoga Prairie, north of Istokpoga Creek, *Small, Mosier & DeWinkeler 10900* (DUKE, PENN, TENN, WVA). Hillsborough Co.: Sun City, *Wood & Clement 7512, 7512a* (GH); Tampa Bay, *O'Neill*, 1927 (CAS, FLAS); Tampa, *Churchill*, 1897 (GH, MO); Ballast Point, West Tampa, *Churchill*, 1923 (GH, US); Sulphur Spring, Tampa, *Churchill*, 1923 (GH); Tampa, *Garber*, 1876 (F, NY, US); Uceta, near Tampa, *Bailey & Bailey 6720* (NY); Tampa Bay, *Hulse* (NY); Sutherland, *Barnhart 2761*. Indian River Co.: near Felsmere, *Small, DeWinkeler & Mosier 11110* (NY, US). Lee Co.: west of Fort Myers, *Moldenke 958* (DUKE, PENN, NY, US); Ft. Myers, *Harshberger*, 1912 (PENN), *Hitchcock 83* (GH, KSC, MO, NY, US), *Westgate 3355, 3404* (F); Punta Rasa, *J. Standley*, 1916 (US). Manatee Co.: Manatee River, *Rugel 156* (GH, NY); Palmetto, *Kelbert & Weber*, 1928 (FLAS); Bradenton, *Wheeler*, 1924 (F); Bradenton, *Cuthbert*, 1926 (FLAS): 6 mi. east of Manatee, *Oosting 172* (DUKE). Marion Co.: 3 mi. south of Orange Springs, *West & Arnold*, 1942 (FLAS). Orange Co.: *Murrill*, 1941 (FLAS); west of Bithlo on Route 50, *Wood & Clement 7191* (GH). Osceola Co.: Campbell Station, Kissimee, *Singletory 263* (DUKE); Boyce's Place, Kissimee, *Singletory*, 1936 (DUKE). Palm Beach Co.: 3 mi. west of Delray Beach, *Fox*, 1945 (WVA). Pinellas Co.: Pinellas Point, St. Petersburg, *M. Williams*, 1926 (PH, DUKE); Dunedin, *Tracy 6833* (F, GH, NY, US). Polk Co.: *J. D. Smith*, 1880 (US); sandy soil, Conine, *Goodale 69916* (GH); Winter Haven, *McFarlin 4797* (CAS); Bartow, *Buswell*, 1919 (MIAMI). Putnam Co.: 3 mi. south of Clay Co. line on U. S. Route 17, *Wood & Clement 7170* (GH); Palatka, *C. Williamson* (PH). Sarasota Co.: Sarasota, *Vanderbilt*, 1941 (NY); Venice, *Wood & Clement 7508, 7508a* (GH); Osprey, *B. H. Smith*, 1904 (PH, DUKE).

Seminole Co.: Longwood, *Beardslee*, 1928 (UC); Oviedo, *Walker 1748* (PH, PENN). St. Johns Co.: *Reynolds* (US); *J. D. Smith*, 1879 (US); 4 mi. west of St. Augustine, *West & Arnold*, 1940 (FLAS). Volusia Co.: Ormond, *Butts*, 1943 (GH); High Banks, 2.5 mi. south of Crows Bluff (Lake Co.), *R. & L. Hindery*, 1941 (FLAS).

Tephrosia Rugelii is an interesting species which stands apart from its relatives of the southeastern United States in its monopodial habit. The plant may be distinguished from other Florida species by its decumbent, monopodial stems, its 9–17 relatively small, uniform leaflets which are broadest above the middle and, particularly, by the flowers borne 1–3 in the axils of leaves. It is sometimes confused with *Tephrosia spicata* but that species branches sympodially, has leafless inflorescences with as many as 20 nodes and the flowers are borne in the axils of persistent bracts. The leaflets of *T. spicata* are generally larger.

The upper surfaces of the leaves of *T. Rugelii* are usually covered with fine hairs, but plants with the upper surfaces glabrous are known from two colonies in southwestern Florida (*Wood & Clement 7512a, 7508a*) where they occur with the typical form.

16. **Tephrosia spicata** (Walt.) T. & G.

Orobus virginianus, etc. Pluk. Mant. 142. 1700.
Clitoria foliis pinnatis, etc. L. Hort. Cliff. 498. 1737.
Erebinthus Mitch. Act. Nat. Cur. **8:** app. 210. 1748.
Cracca leguminibus retrofalcatis, etc. L. Nov. Pl. Gen. 31–32. 1751.
Cracca virginiana L. Sp. Pl. **2:** 752. 1753, in part. (GH-photograph of *Galega*, Sheet 5, Herb. L.)
Galega virginiana L. Syst. Nat. ed. 10. **2:** 1172. 1759, as to plant described.
Galega spicata Walt. Fl. Carol. 188. 1788. (GH-photograph of Type in Herb. Walt.)
Tephrosia spicata (Walt.) T. & G. Fl. N. Amer. **1:** 296. 1838.
Cracca spicata (Walt.) Kuntze, Rev. Gen. **1:** 175. 1891.
Tephrosia paucifolia Nutt. Gen. N. Amer. Pl. **2:** 119. 1818. "In Georgia and Florida, Dr. Baldwyn." (GH-ex Nuttall Coll., presented by Durand, 1866, marked "Tephrosia paucifolia, Southern States.")
Galega paucifolia (Nutt.) M. A. Curt. Bost. Jour. Nat. Hist. **1:** 122. 1835.
Tephrosia hispida DC. Prod. **2:** 250. 1825. "In Carolina."
Tephrosia hispidula γ T. & G. Fl. N. Amer. **1:** 297. 1838. "Middle Florida, Dr. Chapman."
Tephrosia flexuosa Chapm. MSS.; T. & G. Fl. N. Amer. **1:** 297. 1838, in syn. *T. hispidula* γ, not *T. flexuosa* G. Don. 1832.

Cracca spicata flexuosa Vail, Bull. Torr. Cl. **22:** 30. 1895, as new combination based on *T. flexuosa* Chapm., but actually the first valid publication of the name. "Florida, *Chapman*" (NY-Type).

Tephrosia villosa var. *flexuosa* (Vail) Robinson, Bot. Gaz. **28:** 200. 1899, new combination; *T. flexuosa* Chapm. and *C. spicata* var. *flexuosa* Vail cited.

Cracca flexuosa (Vail) Heller, Cat. N. Amer. Pl. ed. 2. 7. 1900, basonym erroneously attributed to Chapm.

Tephrosia mollissima Bertol. Mem. Acad. Sci. Bolog. **2:** 274. 1850. Alabama. Illustration: Bertol. Misc. Bot. **9:** pl. 3. 1851.

Tephrosia spicata var. *semitonsa* Fern. Rhodora **42:** 456. 1940. White sand of pine and oak woods at Round Gut, southwest of Franklin, Southampton County, Virginia, *Fernald & Long 11353*, 20 Sept. 1939 (GH-Type; NY, US).

Erect or decumbent perennial herb from a woody crown and a cylindrical, pale brown tap-root; stems 1–many, branching sympodially, flexuous, terete or angled, leafy from the base. Stems, petioles, rachises and petiolules strigose or hirtellous and hirsutulous to hirsute with yellowish or rusty hairs. Leaves ascending, principally 4–12 cm. long, the petioles 1–24 mm. (rarely 30 mm.) long, usually shorter than the lowermost leaflet; stipules lanceolate to linear, acute or acuminate, 8–9 mm. or less long, green, persistent; leaflets of the principal leaves 9–*11*–17, oblong-obovate to obovate or elliptic (or narrowly so) to oblong-elliptic, the apex very obtuse, mucronate, 11–27 mm. long, 6–13 mm. wide (occasionally 32 x 14 mm.), the terminal leaflet sometimes larger than the lateral (rarely 37 x 17 mm. or 40 x 22 mm.), the leaflets thin, finely hirtellous to hirsutulous or glabrous above, hirsutulous or short-strigose to hirsute or somewhat strigose (but the hairs not tightly appressed) beneath with yellowish or rusty hairs, the veins prominent, often reddish below. Principal inflorescences apparently opposite the leaves or terminal, 4–60 cm. long, erect or curving upward, generally exceeding the leaves, rigid, leafless, bearing flowers at 2–15 (occasionally 20) nodes which are often crowded above, the peduncle stout, terete, angled or sometimes flattened but not conspicuously so; buds 2–5 at a node, 1–3 of these developing and fruiting. Primary bracts lanceolate to linear, acute or acuminate, the lowermost 5–11 (–13) mm. long, the upper smaller, persistent, conspicuous, spreading; secondary bracts lanceolate to linear, acute or acuminate, 9 mm. or less long, that on either side of the primary bract very conspicuous, persistent. Pedicels stout, both hirtellous and hirsutulous or hirsute, 1–6(–8) mm. long, ascending. Dried flowers 12–17 mm. long. Calyx 6–7 mm. long, sparsely to densely hirtellous or hirsutulous or hirsute with cinereous and rusty hairs, the lobes somewhat variable, but usually deltoid to lanceolate (or linear), rather long-acuminate, the upper 2.5–5 mm. long, the lateral 3–5 mm. long, the lowermost 4–6 mm. long. Corolla white (the back of the banner yellowish, faintly veined with red), becoming pink and then carmine with age and purple upon drying; blade of the banner subquadrate to suborbicular, 11–15 mm. high, 11–15 mm. broad; wings 13–15 mm. long,

auricled; keel 12–13 mm. long, with or without an auricle. Staminal tube 8–10 mm. long, the vexillary stamen free, with a distinct, usually 3-lobed callosity on the upper side near the base. Ovary densely short-strigose or rarely glabrous except along the upper suture. Legume slightly curved downward, 3–5 cm. long, 4.5–6.5 mm. wide, usually ascending, hirsutulous with yellowish or rusty spreading hairs or very rarely nearly glabrous except along the upper suture; seeds 6–15, subglobose or flattened on the ends through crowding, 2.4–2.8 mm. in diameter, black to brown or gray, variegated with black. Somatic chromosomes 22. Flowering collections in January in southern Florida, late April to late June in the North and through August into September in most parts of the range.

Distribution. Dry or well-drained, usually sandy soils in open woods and pinelands, Sussex County, Delaware, southward to Dade County, Florida, and westward to Holmes and Wilkinson Counties, Mississippi, and Calcasieu Parish, Louisiana, with scattered stations in eastern Tennessee and southeastern Kentucky. Map 9.

Representative specimens. UNITED STATES. Delaware. Sussex Co.: *Canby*, 1863 (GH, MO); Laurel, *Commons*, 1880 (MO, NY, PH); Georgetown, *Williamson*, 1908 (PENN, PH), *Britton 6* (NY). Maryland. Wicomico Co.: Salisbury, *Shreve & Jones 1276* (US), *Moyer*, 1867 (US), *Wherry & Pennell 12821* (PH), *Bebb*, 1863 (F, MO). Worcester Co.: Ferry Creek, *Redmond 404* (DS); Snow Hill (GH).

Virginia. Greenville Co.: Quarrel's Creek below Pair's Store, *Fernald & Lewis 14622* (GH). Henrico Co.: Elko, *Wherry & Pennell 12477* (MO, PH). Isle of Wight Co.: south of Zuni, *Fernald & Long 6611* (GH, NY, PENN, US). Mecklenberg Co.: 9 mi. north of Clarksville, *White*, 1945 (GH). Nansemond Co.: Kilby, *Fernald, Long & Fogg 4892* (GH, PENN). Princess Anne Co.: Creed's, *Fernald & Long 3973* (GH, PENN). Prince George Co.: 3 mi. s.e. of Petersburg, *Fernald, Long & Smart 5806* (GH, NY, PENN). Southampton Co.: Round Gut, s.w. of Franklin, *Fernald & Long 11353* (GH, NY, US); Franklin, *Heller 1028* (CAS, DS, GH, MO, NY, PENN, PH, UC).

North Carolina. Bladen Co.: Elizabethtown, *Heller 14032* (DS). Brunswick Co.: 3.5 mi. n.e. of Bolivia, *Wood & Clement 7050* (GH). Catawba Co.: swamp north of Hickory, *Small & Heller 31* (CAS, NY, PH, US). Cherokee Co.: s.w. corner of county, *Correll 3583* (DUKE). Chowan Co.: Edenton, *L. & F. Randolph 619* (GH). Cumberland Co.: *Blomquist 3906* (DUKE). Currituck Co.: Currituck, *Bartley & Pontius 437* (NY). Dare Co.: Roanoke Island, *Schallert*, 1941 (NY, UC). Gates Co.: Gatesville, *Godfrey 5222* (GH). Granville Co.: Little River, Camp Butner, *Patten 180* (DUKE). Halifax Co.: Weldon, *Canby*, 1878 (F), *Williamson*, 1895 (PH). Harnett Co.: Erwin, *Godfrey 4627* (DUKE, GH, US). Hyde Co.: 4 mi. s.e. of Leechville, *Wiegand & Manning 1565* (GH, POM). Iredell Co.: Statesville, *Hyams*, 1879 (KSC, MO, NY, POM). Johnston Co.: 5 mi. north of Newton Grove, *Hood 147* (MO), *Rogers 192* (DUKE). Macon Co.: Franklin, *Dunham 22* (F). Moore Co.: Southern Pines, *Blankinship*, 1895 (GH). Nash Co.: Middlesex,

Blomquist 6635 (DUKE). New Hanover Co.: Carolina Beach, *Godfrey 4702* (GH). Onslow Co.: Swansboro, *Wood 6483* (GH). Pamlico Co.: Arapahoe, *Oosting 33227* (DUKE). Pitt Co.: 15 mi. s.e. of Greeneville, *Blomquist 11236* (DUKE). Polk Co.: Godshaw Hill, Tryon, *Peattie 970, 980* (F). Richmond Co.: 5 mi. s.w. of Rockingham, *Wood & Clement 7608* (GH). Rockingham Co.: Spray, *DeChalmot* (US). Rutherford Co.: Chimney Rock. *Biltmore Herb. 1395b* (GH, MO, NY, US). Rowan Co.: Salisbury, *Heller*, 1890 (F, MO, NY, PENN, PH, UC). Sampson Co.: Clinton, *Atchison 38* (GH). Stanley Co.: Falls of the Yadkin River, *Small*, 1892 (NY, PH). Transylvania Co.: Falloway, *Coughey 373* (DUKE). Wake Co.: Lake Myra, *Blomquist 3093* (DUKE). Washington Co.: Roper, *Godfrey 4286* (GH, US). Wilson Co.: *Pattern 131* (DUKE).

South Carolina. Aiken Co.: Aiken, *Ravenel* (NY, US). Anderson Co.: Anderson, *J. Davis*, 1919 (TEX). Berkeley Co.: St. Stephens, *Martin* 1752 (DUKE). Beaufort Co.: Beaufort, *Wood & Clement 7106* (GH). Charleston Co.: Charleston, *W. Palmer*, 1902 (GH, US). Chesterfield Co.: 2 mi. s.w. of McBee, *Wood & Clement 7600* (GH). Darlington Co.: Hartsville, *B. Smith*, 1932 (NY). Florence Co.: 6 mi. south of Florence, *Wiegand & Manning 1567* (GH). Georgetown Co.: 5.5 mi. south of Georgetown, *Godfrey & Tryon 203* (CAS, DUKE, GH, MO, NY, US). Greenville Co.: *J. D. Smith*, 1881 (US). Horry Co.: 15.8 mi. north of Myrtle Beach of Route 17, *Wood & Clement 7072* (GH). Lexington Co.: 14 mi. south of Columbia, *Godfrey & Tryon 1310* (GH, NY, US). Marlboro Co.: 2 mi. south of N. Carolina boundary on U. S. Route 1, *Wood & Clement 7606* (GH). Oconee Co.: Keowee, *House 2203* (NY, US). Pickens Co.: Calhoun, *House 3498* (NY); Table Rock, *Rodgers*, 1941 (DUKE). Spartanburg Co.: Campobello, *E. Walker 3485* (DUKE). Sumter Co.: Sumter, *Brownfield*, 1894 (US). Williamsburg Co.: Santee River, 17 mi. south of Kingstree, *Wiegand & Manning 1568* (GH).

Georgia. Bartow Co.: 3 mi. south of Allatoona Dam, *Duncan 8420* (UC). Camden Co.: 2 mi. north of Kingsland, *Wood & Clement 7131* (GH). Chatham Co.: Wilmington Id., Ft. Pulaski National Monument, *Eyles 4112* (DUKE). Clarke Co.: Athens, *Perry 909* (GH, PENN, NY, US). DeKalb Co.: Stone Mt., *Eggert*, 1897 (NY, TEX, UC, US). Dougherty Co.: Albany, *Pollard & Maxon 510* (NY, US). Fannin Co.: Blue Ridge, *Huger*, 1900 (NY). Floyd Co.: Mt. Berry, *H. Jones*, 1935 (GA). Fulton Co.: East Point, *Scheer*, 1916 (GA). Gwinnett Co.: Thompsons Mills, *Allard 110* (NY, US). Houston Co.: Wellston, *Ainsworth 44530* (PH). Jasper Co.: Monticello, *Porter*, 1846 (GH, F, PH). Jefferson Co.: *Hopkins*, 1897 (NY). Lamar Co.: Barnesville, *Hamlin E7856* (GA). Rabun Co.: Clayton, *Reade*, 1911 (DUKE). Richmond Co.: 15 mi. s.w. of Augusta, *Wood & Clement 7582* (GH). Spalding Co.: Pomona, *Riegel*, 1899 (KSC). Ware Co.: *Erlanson 292* (US). Washington Co.: 25 mi. west of Sandersville, *Erlanson 333* (GA, US). Whitfield Co.: west of Dalton, *Harper 397* (NY).

Florida. Broward Co.: between Ft. Lauderdale and Miami, *Small, Carter & Small*, 1911 (NY); west of Davie, *Moldenke 455*, 1930 (NY, PENN). Clay Co.: 7 mi. south of Green Cove Springs, *Wood & Clement 7166* (GH). Columbia Co.: 5 mi. east of Fort White, *West & Arnold*, 1946 (FLAS). Dade Co.: Humbugus Prairie (between Miami and Fulford), *Small, Mosier & Small 6890* (DUKE, FLAS, GH, NY, PENN, TENN, WVA, US). Dixie Co.: 10 mi. west of Shamrock, *Pasture Survey*, 1937 (FLAS). Duval Co.: Jacksonville, *Curtiss 580* (A, GH, MO, NY, PENN, PH, US), *4232* (DS, NY, UC, US), *6419* (DS, GH, MO, NY, UC, US). Escambia Co.: Pensacola, *Brinker 51* (MO, UC). Franklin Co.: Apalachicola, *Chapman* (DS, MO). Hillsborough Co.: Riverview, *Wood & Clement 7516* (GH). Lake Co.: Eustis, *Hitchcock*, 1894 (F, FLAS, KSC, MO), *Nash 754* (GH, MO, NY, POM, UC, US). Lee Co.: Ft. Myers, *J. Standley 167* (CAS, DS, GH, NY, PH, UC, US). Leon Co.: Tallahassee, *Berg*, 1895 (F, NY). Levy Co.: Raleigh, *Wood & Clement 7531* (GH). Liberty Co.: north of Roy, *Wiegand & Manning 1571* (GH). Manatee Co.: Bradenton, *Weber*, 1928 (FLAS). Marion Co.: Irvine, *Moldenke 1089a* (NY, PENN). Pasco Co.: St. Leo, *O'Neill* (FLAS). Polk Co.: Ft. Meade, *J. D. Smith*, 1880 (US); Bartow, *McFarlin 555* (TEX). Seminole Co.: Forest City, *Lewton*, 1894 (NY). Suwanee Co.: Live Oak, *Wiegand & Manning 1569* (GH, PENN). Volusia Co.: Orange City, *Hood*, 1910 (FLAS). Walton Co.: 18 mi. east of Freeport, *Erlanson 222a* (US).

Kentucky. McCreary Co.: high ridge above Coffee Branch, *Braun 4259* (GH, Herb. Braun). Whitley Co.: Cumberland Falls, *Braun 627* (Herb. Braun), *McFarland*, 1940 (CAS, DUKE, GA, GH, MO, NY, PH, TENN, UC, WVA). Tennessee. Cocke Co.: Wolf Creek, *Kearney*, 1894 (F, GH, MO, NY, US); French Broad River between Paint Rock and Del Rio, *Kearney 642* (MO, NY, US). Hamilton Co.: Missionary Ridge, Chatanooga, *Freeman & Freeman*, 1921 (US); Lookout Mt., *Vasey*, 1878 (PH). Knox Co.: 2 mi. s.w. of Univ. Tenn. Farm, *Hesler 3021* (NY, TENN). Loudon Co.: just east of Roane Co. line on U. S. Highway 70, *Sharp & Clebsch 6878* (TENN). Marion Co.: ridge west of Whitwell, *Sharp & Underwood 2586* (TENN). Meigs Co.: Decatur, *Underwood & Sharp 2297* (PENN, TENN).

Alabama. Baldwin Co.: Magnolia Springs, *Schallert 817* (DUKE). Blount Co.: *Mohr*, 1889 (US). Cherokee Co.: Lookout Mt., *Freeman*, 1905 (KSC). Crenshaw Co.: Dozier, *Reed 2100* (TEX). Cullman Co.: Cullman, *Sudworth*, 1891 (US). Escambia Co.: Atmore, *Blanton 195* (GH). Jackson Co.: DeSoto Falls, *Wherry*, 1933 (PENN). Jefferson Co.: Birmingham, *Hitchcock*, 1898 (F). Lee Co.: Auburn, *Earle & Baker*, 1897 (GH, KSC, MO, NY, US). Macon Co.: Notasulga, *Underwood*, 1896 (NY). Marshall Co.: 3.2 mi. north of Boaz, *Hubricht B1665* (MO). Mobile Co.: Mobile, *Mohr* (DS, US). Shelby Co.: Calera, *Everts* (NY). St. Clair Co.: Cook Spring, *Barnhart 554* (NY). Tallapoosa Co.: *Pollard & Maxon 135* (US). Tuscaloosa Co.: Tuscaloosa, *E. A. Smith*, 1893 (US).

Mississippi. Clarke Co.: Enterprise, *Tracy 3268* (part) (NY). Holmes Co.: *McGee*, 1892 (NY). Jackson Co.: Ocean Springs, *Seymour 46* (CAS, DUKE, GH, MO). Jasper Co.: Heidelburg, *Tracy 3226* (MO). Pearl River Co.: *Erlanson 178* (US). Pike Co.: Holmesville, *Wheeler* (MO). Smith Co.: Taylorville, *Tracy 8501* (GH, MO, NY, PENN, US). Wayne Co.: Waynesboro, *Pollard 1225* (GH, MO, NY, US). Wilkinson Co.: *Phares 1704* (KSC). Louisiana. Calcasieu Parish: Lake Charles, *Allison 59* (US). St. Tammany Parish: Covington, *Langlois*, 1895 (DS), *Bro. Arsène 11510, 11579*, etc. (US). Tangipahoa Parish: 3 mi. south of Hammond, *Erlanson 148* (US).

Tephrosia spicata is likely to be confused only with *T. Rugellii* (see discussion of that species) and with *T. hispidula* among the species of the southeastern United States. Although plants of *T. hispidula* with spreading pubescence have been identified by Rydberg and others as *T. spicata*, the two are quite different, particularly in the calyx, leaflet-number, -shape and -size, and inflorescence, as indicated in Key 2.

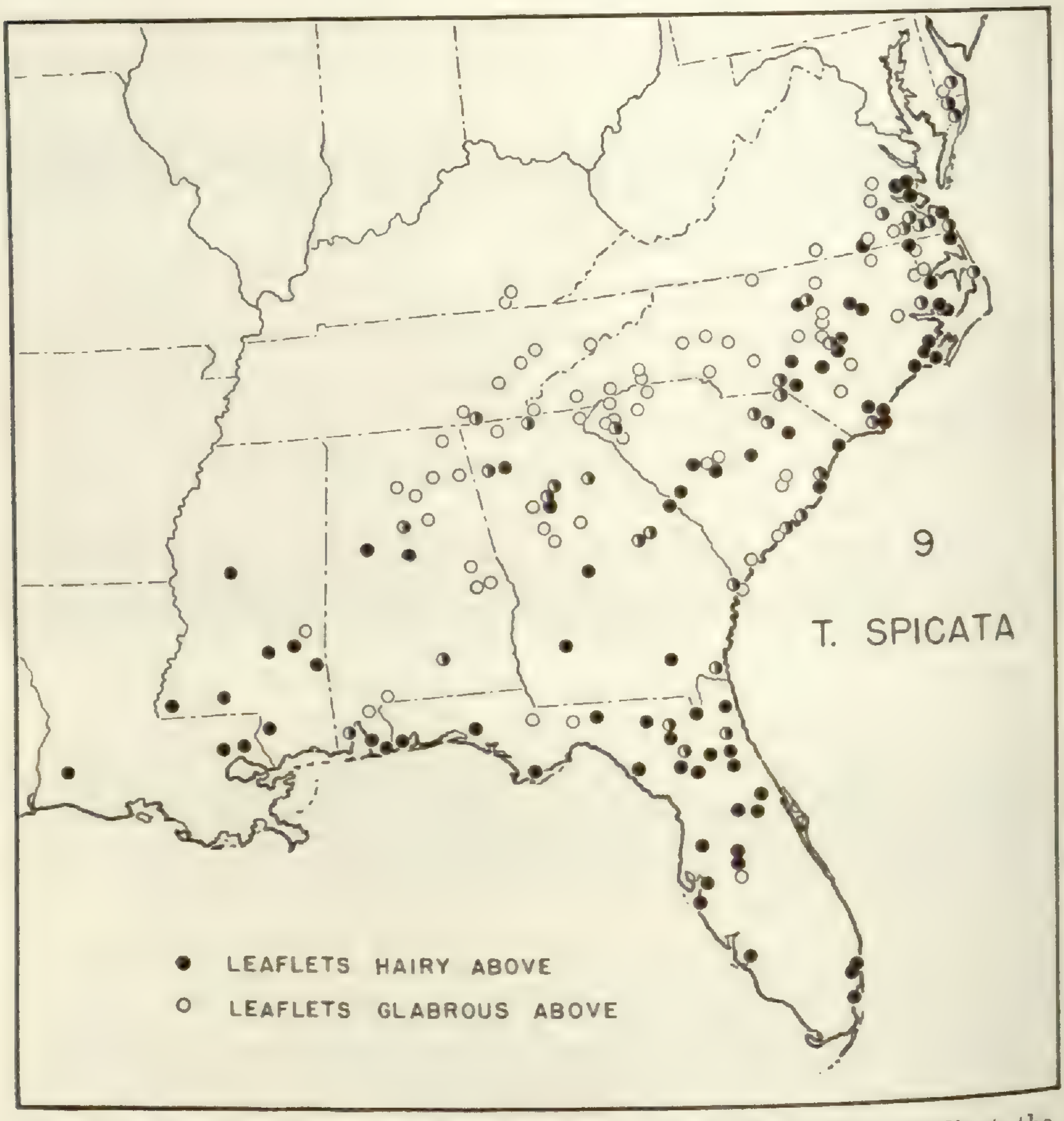
Two pubescence-forms of *Tephrosia spicata* occur, one with the upper surfaces of the leaflets completely glabrous, the other with the upper surfaces hirtellous or hirsutulous in varying degrees. A few intermediates are also found. No other differences between the two types are evident. The partially glabrous form has been designated *T. spicata* var. *semitonsa* Fernald (Walter described the hairy plant), but its importance as a geographical segregate is greatly weakened by the occurrence of both types of plants throughout most of the range of the species. Indeed, both may occur within the same colony, although the proportions vary from place to place. Few large collections are available, but three made in the summer of 1947 are interesting in this connection:

	Plants with leaflets hairy above		Plants with leaflets glabrous above	
Beaufort Co., N. C.	53	(98.2%)	1	(1.8%)
Georgetown Co., S. C.	26	(99.3%)	2	(0.7%)
Charleston Co., S. C.	32	(60.5%)	21	(39.5%)

Colonies consisting entirely of either type were also found. Map 9 indicates further the large number of localities or collections in which both glabrous and hairy plants occur. The slight segregation of the glabrous form in western North Carolina and eastern Tennessee and Kentucky and of hairy plants in Louisiana and

part of Florida may be more apparent than real, but this can be determined only by more careful collecting.

A peculiar, little-known form with linear leaves 1–5 cm. long and 2–6 mm. wide has been named *Cracca flexuosa* (Vail) Heller. The specimens all appear to have been stiffly erect and some give



Map. 9. Distribution of Tephrosia spicata. Half-filled circles indicate the occurrence of both pubescence-types in the same collection or at the same locality. See accompanying text.

the impression of having been injured. The inflorescences, which bear 1–8 flowering nodes, are usually partly leafy. The legume, calyx and coarse, over-all pubescence are, however, characteristic of *Tephrosia spicata*, of which this appears to be merely a form. The following specimens are referable to this name:

FLORIDA. *Chapman* (MO, NY, PH); probably collected by *Chapman* (F). ALABAMA. *Dr. Gates* (NY); ? Mobile, *Mohr* (F). Mobile Co.: dry, sandy pine barrens, Spring Hill, *Mohr*, Aug. 1878 (US). MISSISSIPPI. Jackson Co.: Ocean Springs, *Tracy*, 11 June 1898 (MO). Harrison Co.: Gulfport, *Lloyd & Tracy 161*, 8 Sept. 1900 (NY).

17. **Tephrosia hispidula** (Michx.) Pers.

Galega hispidula Michx. Fl. Bor. Amer. **2:** 6. 1803. "In Virginia, Carolina et Georgia." (GH-photograph of Type in Herb. Mus. Paris.)

Tephrosia hispidula (Michx.) Pers. Syn. Pl. **2:** 329. 1807.

Cracca hispidula (Michx.) Kuntze, Rev. Gen. **1:** 175. 1891.

Tephrosia gracilis Nutt. Gen. N. Amer. Pl. **2:** 119. 1818. "In Carolina and Georgia" (GH).

Tephrosia elegans Nutt. Jour. Acad. Phila. **7:** 105. 1834, not Schum. ex Schum. & Thonn. 1827. "Hab. in Alabama." The description applies most nearly to *T. hispidula*, although it is not very definite. I have, however, seen no material of this species from Alabama.

Erect or decumbent perennial herb up to 5 dm. high from a slender woody crown and dark-brown, woody, fusiform tap-root, up to 3 dm. long, 1 cm. thick, which sometimes bears a few short branch roots near the upper end; stems slender, branching sympodially or partially so. Stems, petioles, rachises and axes of the inflorescences sparsely to densely strigillose to short-strigose or hirsutulous with cinereous or brownish hairs. Leaves (3–)5–10(–11) cm. long, ascending, the petioles mostly very short and the leaves nearly sessile or the petioles up to 8 (very rarely 5–20) mm. long, shorter than the lowermost leaflets; stipules linear-acuminate to linear-setaceous, 5–8 mm. or less long, persistent; leaflets of the principal leaves (9–)13–19(–23), oblong to ovate-lanceolate to narrowly elliptic (rarely elliptic or ovate), the apex acute or obtuse but not rounded, mucronate, the base rounded or merely obtuse, 7–22 mm. long, 2–7 mm. wide (very rarely 12 x 7 to 16 x 18 mm.), mostly 2–3 times as long as broad; leaflets membranous, dull, red-veined beneath, glabrous to densely strigillose or hirtellous with cinereous hairs above, sparsely to densely strigillose or hirtellous to hirsutulous with cinereous hairs beneath; petiolules 1 mm. or less long. Inflorescences opposite the leaves, terminal or axillary, slender, (1.5–)2.5–15 cm. long, erect or ascending, usually exceeding the leaves and naked or sometimes with a single leaf, bearing 1–3(–5) flowering nodes near the end; buds 2–3 at a node, one of these fruiting. Primary bracts persistent, narrowly lanceolate to linear-lanceolate, the lowermost often 3-toothed or -parted to the base, 5–7(–9) mm. long. Pedicels slender, almost filiform in flower, becoming stouter in fruit, 2–8 mm. long, ascending. Dried flowers 12–15 mm. long. Calyx 3–4 mm. long, strigillose and short-strigose or hirtellous and hirsutulous with cinereous hairs, the upper and lateral lobes deltoid, abruptly contracted near the tip, 1.5–2(–2.5) mm. long and 1.5–2.5(–3.5) mm. long, respectively, the lowermost lobe narrowly deltoid, acuminate, to lance-acuminate, 2–3(–3.5) mm. long. Corolla white (the back of the banner yellowish, faintly veined with red), becoming

pink and then carmine with age and purple upon drying; blade of the banner rounded-quadrate, 10–12 mm. high, 11–14 mm. broad, hairy on the back; wings 10–14 mm. long, auriculate; keel 10–11 mm. long, auriculate. Staminal tube 8–10 mm. long, the vexillary stamen free, sometimes distinctly thickened on the upper side near the base. Ovary densely short-strigose with stiff, coarse, cinereous or golden hairs. Legume slightly curved downward, 3–4.2 cm. long, 4.5–6 mm. wide, horizontal or ascending, sparsely to moderately hirsutulous with yellowish to cinereous hairs; seeds 10–12, Boston-baked-bean-shaped, 2.6–3.4 mm. long, gray or brown, variegated with black. Somatic chromosomes 22.

Distribution. Dry to moist, or even wet, acid, sandy soils, chiefly in flat pinelands and savannahs on the outer Coastal Plain of the United States from southeastern Virginia (?) and Beaufort and Cumberland Counties, North Carolina, southward to Polk and Osceola Counties, Florida, and with a single collection from Jackson County, Florida. Map 13.

Representative specimens. In most instances, only a single collection is cited from a county.

UNITED STATES. Virginia. Without locality, *Torrey & Gray*, Fl. N. Amer. (GH). North Carolina. Beaufort Co.: savannah, Chocowinty, *Godfrey*, 1938 (GH); savannah, 9.4 mi. south of Washington, *Wood & Clement 6992* (GH, DUKE). Bladen Co.: moist, sandy soil, east of Elizabethtown, *Heller 14056* (DS). Brunswick Co.: 3.5 mi. northeast of Bolivia, *Wood & Clement 7049* (GH). Craven Co.: pine savannah, 3.25 mi. north of Havelock, *Wood & Clement 7004* (GH). Carteret Co.: wet soil, open pineland, Silverdale, *Randolph & Randolph 933* (GH). Columbus Co.: Whiteville, *Schallert 9402* (DUKE); savannah, Old Dock, *Godfrey & Shunk 4191* (GH, US). Cumberland Co.: *Godfrey 4551* (GH, US). New Hanover Co.: savannah s.e. of Wilmington, *Coville 67* (US). Onslow Co.: pineland at Richlands, *Godfrey 4484* (GH, US). Pender Co.: Burgaw, *Blomquist 3904* (DUKE). Robeson Co.: 7 mi. s.e. of Lumberton, *Wiegand & Manning 1555* (GH).

South Carolina. Santee Canal, *Ravenel* (GH). Berkeley Co.: dry, sandy woods, 14 mi. south of Charleston, *Moldenke 1221* (DUKE, NY, PENN, US). Clarendon Co.: 2 mi. north of Manning, *Stone 122* (PH). Dorcester Co.: open pine woods, Summerville, *Hexamer & Maier*, 1855 (GH). Georgetown Co.: upland grass-sedge bog or savannah, 5 mi. south of Andrews, *Godfrey 145* (CAS, GH, MO, NY, US). Hampton Co.: sandy, peaty barrens 3 mi. n.w. of Early Branch, *Wiegand & Manning 1557* (GH, POM). Williamsburg Co.: 4 mi. north of Kingstree, *Wiegand & Manning 1556* (GH).

Georgia. *Nuttall* (GH). Bulloch Co.: dry pine barrens, *Harper 849* (GH, NY, US). Camden Co.: wet pineland, ca. 2 mi. north of Kingsland, *Wood & Clement 7133* (GH). Chatham Co.: Whitemarsh Id., Ft. Pulaski National Monument, *Eyles 4331* (DUKE). Emanuel Co.: moist pine savannah at edge of oak barren, 3 mi. north of Oak Park, *Wood & Clement 7566* (GH). Glynn Co.: just west of Brunswick, *Wood & Clement 7120*

(GH). McIntosh Co.: damp pine woods, 7 mi. north of Darien on Route 17, *Wood & Clement 7115* (GH). Screven Co.: fine sandy soil at edge of "bay", 9 mi. east of Millen, *Duncan 5544* (GA). Ware Co.: moist pine woods, 14 mi. s.w. of Waycross, *Wood & Clement 7552* (GH). Wayne Co.: sandy soil near Jessup, *Biltmore Herb. 1389f* (US).

Florida. *Nash 1428, 1480, 922* (NY); *Chapman* (GH, MO, NY); *Powell*, 1872 (US); *Curtiss*, 1875 (US). Alachua Co.: Gainesville, *Garber* (CAS, NY, US), *Weber*, 1933 (FLAS). Clay Co.: Penney Farms, *Ritchey*, 1934 (FLAS). Columbia Co.: Lake City, *Hitchcock*, 1898 (F, MO); moist pineland, 7 mi. north of Lake City, *Wood & Clement 7549a* (GH). Duval Co.: near Jacksonville, *Curtiss 581* (GH, MO, NY, PENN, PH, POM), *4230* (DS, NY, UC, US), *5682* (FLAS, GH, KSC, MO, NY, POM, UC, US). Jackson Co.: 4 mi. east of Marianna, *Erlanson 229* (GH). Lake Co.: vicinity of Eustis, *Nash 804* (GH, MO, NY, PH, UC, US). Lee Co.: open woods south of Ft. Myers, *Wherry*, 1930 (PENN). Levy Co.: flatwoods near Lebanon, *Pasture Survey*, 1937 (FLAS). Marion Co.: 1.5 mi. east of Orange Springs, *West & Arnold*, 1941 (FLAS). Nassau Co.: wet pineland, just north of Gross, *Wood & Clement 7136* (GH). Orange Co.: *Meislahn 44* (US); *Baker*, 1934 (MIAMI); Lake Brantley, *Lewton*, 1893 (NY); wet pineland, Christmas, *Wood & Clement 7194* (GH). Osceola Co.: *Mearns*, 1901 (US). Pinellas Co.: St. Petersburg, *M. Williams*, 1926 (PH, DUKE). Polk Co.: Bartow, *Buswell*, 1919 (MIAMI). Putnam Co.: low turkey-oak woods, Welaka, *Laessle*, 1940 (FLAS). St. Johns Co.: 1.8 mi. north of Switzerland, *Murrill*, 1941 (FLAS). Union Co.: 5 mi. south of Raiform, *West & Arnold*, 1942 (FLAS).

Tephrosia hispidula is remarkable among the Tephrosias of the southeastern United States in inhabiting moist or even wet pinelands, although it is not confined to such habitats and often grows in well-drained, sandy soils. All of the other southeastern species seem to require very well-drained soils. The slender, erect or decumbent plants of this species, however, may regularly be looked for in southeastern North Carolinain moist pine savannahs where they often occur with *Dionaea*. In coastal Georgia I have seen the species growing with *Sarracenia* and in northern Florida on slight rises in wet pineland. Although it occurs in dry pinelands as well, it appears to be absent from oak-barrens and is thus usually ecologically isolated from *Tephrosia florida* and always from *T. chrysophylla*. *Wood & Clement 7567*, 3 mi. north of Oak Park, Emanuel Co., Ga. (GH), consists of plants morphologically intermediate between *T. hispidula* and *T. florida*. These grew in a narrow transition zone between pine grassland and an oak-barren where the two species grew and may represent hybrids. (See Distribution and Ecology.)

All reports of *Tephrosia hispidula* from Alabama, Mississippi and Louisiana seem to be based on small or depauperate plants of *T. florida* which sometimes resemble this species in vegetative characters. I have seen no specimens from west of Jackson County, Florida. Although the calyx of *Tephrosia hispidula* resembles that of *T. florida*, the ovary and legume are short-strigose or hirsutulous in the former and merely strigillose or hirtellous in the latter.

Pubescence of the leaflets in this species follows the four types described under *Tephrosia onobrychoides*, although plants with the upper surfaces of the leaflets glabrous and the pubescence on the lower surfaces spreading are rare. There is no geographical segregation of any of these types; two or more often occur in the same colony. Only three large collections have been made but these show more or less random distribution of pubescence-types. For example, in one from Beaufort County, North Carolina, consisting of 77 plants, the leaflets of 36 were glabrous above and strigillose beneath, while 23 were appressed-pubescent on both surfaces and 18 spreading-pubescent on both surfaces!

(*To be continued*)

CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD UNIVERSITY—No. CLXX

THE AMERICAN BARBISTYLED SPECIES OF TEPHROSIA (LEGUMINOSAE)

CARROLL E. WOOD, JR.

(Continued from page 302)

18. **Tephrosia florida** (F. G. Dietr.) comb. nov.

Galega villosa Michx. Fl. Bor. Amer. **2:** 67. 1803, not. L. 1753. Carolina to Florida. (GH-photograph of Type in Herb. Mus. Paris.)

Tephrosia villosa (Michx.) Pers. Syn. Pl. **2:** 329. 1807, not (L.) Pers. 1807.

Galega florida F. G. Dietr. Vollst. Lexik. Gaertn. Nachtr. **3:** 422. 1817. Carolina and Florida. Based on *Galega villosa* Michx. See discussion below.

Galega ambigua M. A. Curtis, Bost. Jour. Nat. Hist. **1:** 121. 1835. "Sandy woods," (near Wilmington, North Carolina). (NY-specimen labeled "*Galega ambigua*, mihi; G. hispidula, P[urs]h. Ell[iott]. non M[i-chau]x., N. Carolin, Curtis."-Type)

Tephrosia ambigua (M. A. Curtis) Chapm. Fl. Southern U. S. 96. 1865.

Cracca ambigua (M. A. Curtis) Kuntze, Rev. Gen. **1:** 174. 1891, basonym wrongly attributed to Chapm.

Tephrosia ambigua var. *gracillima* B. L. Robinson, Bot. Gaz. **28:** 201. 1899. "Dry pine barrens near Eau Gallie, Indian River [Brevard County], Florida," *A. H. Curtiss 584*, July, *5708*, 16 July 1896 (GH-Cotypes; *584*-MO, NY, US; *5708*-FLAS, KSA, MO, NY, POM, UC, US).

Cracca gracillima (Robinson) Heller, Cat. N. Amer. Pl. ed. 2. 7. 1900.

Tephrosia gracillima (Robinson) Killip, Jour. Wash. Acad. Sci. **26:** 360. 1936.

Cracca angustissima (Shuttlew.) Kuntze, sensu Vail, Bull. Torr. Cl. **22:** 32. 1895.

Prostrate to erect herbaceous perennial from a woody cylindrical pale-brown tap-root; stems prostrate or erect (in depauperate specimens), up to 6 dm. long, usually branching sympodially. Stems, petioles, rachises, petiolules and axes of the inflorescences sparsely to densely strigillose or hirtellous to short-strigose or hirsutulous, or sometimes both strigillose and short-strigose or hirtellous and hirsutulous with cinereous or rarely golden hairs. Leaves erect (from prostrate stems) or ascending, 3–28 cm. long, the petioles of the principal leaves 0.3 (in occasional erect plants) to 9.5 cm. long, usually 1–4 times the length of the lowermost leaflets of a leaf; stipules of the lower leaves oblanceolate, acute, to 11.5 mm. long, 2 mm. wide, those of the upper leaves decreasing in size, lanceolate or linear, acute or acuminate, persistent; leaflets of the principal leaves 7–*13*–19, narrowly cuneate to narrowly cuneate-oblong or narrowly elliptic to elliptic, the apex obtuse or retuse, mucronate, often reflexed upward, the terminal leaflet (including the petiolule) 18–52 mm. long, (2–)5–13 mm. wide, the lateral leaflets (including the petiolules) 12–40(–45) mm. long, 2–18 mm. wide, the leaflets dull, glabrous or sparsely to moderately strigillose or hirtellous with fine gray hairs above, sparsely to moderately strigillose or hirtellous to short-strigose or hirsutulous with cinereous hairs beneath, the veins prominent, often reddish. Principal inflorescences apparently opposite the leaves, the smaller inflorescences axillary or terminal, 3.5–23 cm. long, curving upward, often exceeding the leaves, leafless, bearing flowers at 1–6 (rarely 7) nodes, the peduncle flattened, particularly below the nodes, 2-edged, up to 2(–3) mm. wide; buds 2–5 at a node, 1–3 flowering, 1 or 2 fruiting. Primary bracts narrowly oblanceolate to linear, the apex acute, the bract of the first node 3.5–8 mm. long, green, persistent; secondary bracts to 5.5 mm. long. Pedicels (3–)5–12 mm. long, ascending. Dried flowers 10–16 mm. long. Calyx 3–4.5 mm. long, strigillose or hirtellous with cinereous hairs, the upper lobes narrowly deltoid-acuminate, 1.5–2.5 mm. long, the lateral lobes lance-subulate, 1.5–3 mm. long, the lowermost lobe linear-subulate, 2.5–3.5 mm. long. Corolla white (the back of the banner yellowish, faintly veined with red) becoming pink and then carmine with age and purple upon drying; blade of the banner subquadrate to suborbicular, 10–13 mm. high, 11–15 mm. wide, finely hairy on the back, the claw 2–2.5 mm. long; wings 11–15 mm. long, auriculate, the claw 1.5–2 mm. long; keel 10–12 mm. long, with or without an auricle, the claw 2.5 mm. long. Staminal tube 8–9 mm. long, the vexillary stamen free from the tube, usually with a thickening on the upper side near the base. Ovary strigillose; ovules 10–15. Legume slightly curved downward, 3–4.5(–5) cm. long, 4–6 mm. wide, horizontal or ascending, sparsely to moderately strigillose or hirtellous with cinereous hairs; seeds 10–14, subspherical, 2–2.4 mm. in diameter, gray mottled with black or brown. Somatic chromosomes 22.

Distribution. Well-drained, usually open, light, sandy, acid soils in pine and oak woods and barrens on the Coastal Plain from Moore and Carteret Counties, North Carolina, southward to Dade and Lee Counties,

Florida, and westward to Orleans and St. Tammany Parishes, Louisiana, United States. Map 11.

Representative specimens. Citations have, in most instances, been limited to a single collection from each county. UNITED STATES. North Carolina. Brunswick Co.: 3.5 mi. n.e. of Bolivia on Route 17, *Wood & Clement 7951* (GH, DUKE). Carteret Co.: 4.5 mi. west of Morehead City, *Wood & Clement 7025* (GH, DUKE). Hoke Co.: along Drowning Creek, *Correll 1154* (DUKE). Moore Co.: 2 mi. south of Pine Bluff, *Wiegand & Manning 1547* (GH). New Hanover Co.: Carolina Beach, *Godfrey 4704* (DUKE, GH, NY, US). Richmond Co.: 4 mi. east of Hamlet, *Wiegand & Manning 1548* (GH), 5 mi. east, *Heller 14012* (DS). Sampson Co.: 1.5 mi. from county line [Harnett?] on Highway 55, *R. Hood 154* (part) (UC). Scotland Co.: Springfield, *Godfrey 5095* (DUKE, GH).

South Carolina. Aiken Co.: 10 mi. north of Aiken, *Wood & Clement 7589* (GH). Beaufort Co.: Beaufort, *Wood & Clement 7107* (GH). Charleston Co.: Route 17, 14.8 mi. east of the Edisto River, *Wood & Clement 7089* (GH). Chesterfield Co.: 2 mi. south of McBee, *Wood & Clement 7601* (GH). Darlington Co.: Hartsville, *Norton*, 1920 (US). Florence Co.: 5 mi. north of Coward, *Wiegand & Manning 1550* (GH). Georgetown Co.: 15.25 mi. north of Georgetown on Route 17, *Wood & Clement 7075* (GH). Horry Co.: 15.8 mi. north of Myrtle Beach on Route 17, *Wood & Clement 7071* (GH). Kershaw Co.: 3 mi. n.e. of Camden, *Wood & Clement 7598* (GH). Lexington Co.: 14 mi. south of Columbia, *Godfrey & Tryon 1311* (CAS, DUKE, GH, MO, NY, US).

Georgia. Appling Co.: 3 mi. north of Baxley, *Wood & Clement 7560* (GH). Decatur Co.: Flint River at West Bainbridge, *Harper 1238* (GH, NY, US). Dougherty Co.: near Albany, *McKellar*, 1937 (GA). Baker Co.: Flint River at Ichanochaway Creek, *Duncan 6647* (GA). Echols Co.: Mayday, *McKellar*, 1937 (GA). Emanuel Co.: 3 mi. north of Oak Park, *Wood & Clement 7575* (GH). Lanier Co.: Lakeland, *McKellar*, 1937 (GA). Liberty Co.: 4 mi. s.w. of Hinesville, *Wiegand & Manning 1522* (GH). McIntosh Co.: 5 mi. north of Darien, *Wood & Clement 7117* (GH). Toombs Co.: 7 mi. south of Lyons, *Wood & Clement 7563* (GH). Ware Co.: 2 mi. n.e. of Waycross, *Erlanson 294* (UC).

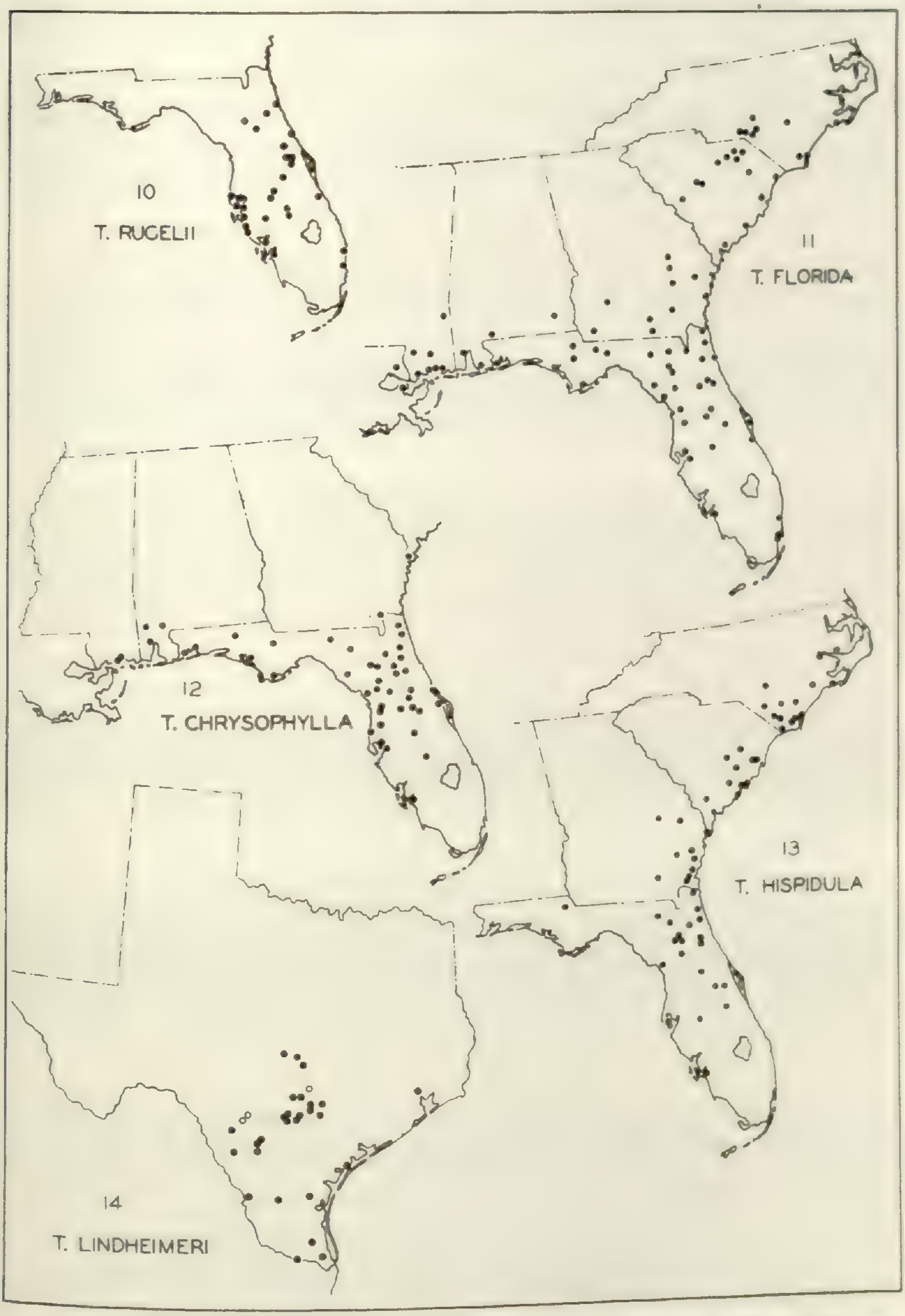
Florida. Alachua Co.: High Springs, *Wood & Clement 7539, 7540* (GH). Baker Co.: McClenny, *Futch*, 1936 (FLAS). Bay Co.: Lynn Haven, *Billington 19* (US). Brevard Co.: Eau Gallie, *Curtiss 584* (GH, MO, NY, US), *5708* (FLAS, GH, KCS, MO, NY, POM, UC, US), *Wood & Clement 7202* (GH, DUKE), *G. Bates*, 1889 (F). Broward Co.: between Ft. Lauderdale and Miami, *Small, Carter & Small*, 1911 (NY). Calhoun Co.: Blounttown, *Erlanson 226* (US). Clay Co.: Green Cove Springs, *Wood & Clement 7153* (GH). Citrus Co.: 10 mi. south of Dunellon, *Wood & Clement 7527* (GH). Columbia Co.: 5 mi. north of High Springs, *Wood & Clement 7546* (GH). Dade Co.: Buena Vista, *Moldenke 776a* (DUKE, NY, PENN); Miami, *O'Neill 8170* (CAS, F, UC, US); Ross-Costello Hammock, *Small, Mosier & Small 6568* (DUKE, FLAS, NY,

PENN, WVA). Duval Co.: near Jacksonville, *Curtiss 583* (GH, MO, NY, PENN, PH, TENN, UC, US), *4228* (DS, POM, NY, US). Escambia Co.: Pensacola, *McFarlane,* 1905 (PENN). Franklin Co.: Apalachicola, *Chapman* (MO), *Sausman* (PENN). Gadsden Co.: Quincy, *H. Foster*, 1936 (FLAS). Hernando Co.: 15 mi. north of Brooksville, *Crevasse*, 1940 (FLAS). Hillsborough Co.: Riverview, *Wood & Clement 7513* (GH). Jackson Co.: 4 mi. east of Marianna, *Erlanson 229* (UC, US), *230* (US). Lake Co.: Eustis, *Nash 819, 1555* (GH, MO, NY, UC, US), *Hitchcock*, 1894 (F, FLAS, KSC, MO). Lee Co.: north of Estero, *Wood & Clement 7504* (GH). Leon Co.: Tallahassee, *Rugel,* 1843 (part) (MO). Levy Co.: Rosewood, *Garber*, 1876 (US). Marion Co.: 1 mi. east of Orange Springs, *West & Arnold*, 1941 (FLAS). Madison Co.: *Hitchcock*, 1898 (F). Nassau Co.: just north of the Nassau River on U. S. Route 17, *Wood & Clement 7144* (GH). Orange Co.: Lake Brantley, *Lewton*, 1894 (F, NY, PH). Polk Co.: Bartow, *Buswell,* 1919 (MIAMI). Putnam Co.: Crescent City, *Martin*, 1880 (MO). St. John Co.: St. Augustine, *M. Reynolds*, 1877 (NY). Suwanee Co.: 5 mi. west of Live Oak, *Wiegand & Manning 1553* (GH). Volusia Co.: DeLand, *Hulst,* 1891 (NY).

Alabama. Baldwin Co.: 8 mi. north of Fairhope, *Erlanson 205* (F). Dale Co.: *Biltmore Herb. 4682b* (NY). Escambia Co.: Atmore, *Blanton 195* (part) (GH). Mobile Co.: Spring Hill, *Bush 92* (NY), *Drushel,* 1915 (MO). Mississippi. Hancock Co.: Bay St. Louis, *Langlois,* 1883 (DS, NY). Harrison Co.: Biloxi, *Tracy & Lloyd 156* (GH, NY). Jackson Co.: Ocean Springs, *Pollard 1011* (MO, NY, US). Pearl River Co.: Poplarville, *Erlanson 170* (GH, US). Stone Co.: 1 mi. north of Ramsey Hotel, *Brenner*, 1940 (MO). Waynesboro, *Pollard 1255* (MO, NY, US). Louisiana. St. Tammany Parish: Abita Springs, *Pennell 4136* (NY, PENN, PH); Covington, *Bro. Arsène 1164, 11071, 11466, 11474, 11580, 11860* (US). Orleans Parish: New Orleans, *Drummond 84* (GH), *Ingalls* (NY).

Tephrosia florida, as it occurs throughout much of its range, is a plant with prostrate stems and erect or ascending leaves with very long petioles, some of which may be as much as four times as long as the lowermost leaflets of a leaf. The few-flowered inflorescences are usually produced sympodially and curve upward. However, an erect, apparently depauperate form, with very short petioles and ascending, often axillary inflorescences, occurs sporadically. It may, nevertheless, be recognized as this species by the size and shape of the calyx, the strongly flattened two-edged axes of the inflorescences, and the hirtellous legumes.

Very young or depauperate forms of *Tephrosia florida* have been mistaken for *T. hispidula*, especially in the western part of the range of the former species, but may be separated, even in



Distributions of some barbistyled species of TEPHROSIA in the United States. MAP 14. Dots, T. LINDHEIMERI; circles, Texas collections of T. POTOSINA; see also MAP 18, page 323.

flower, by the very short hairs only 0.2–0.4 mm. long on both ovary and pod.

The very narrow-leaved plant known as *Tephrosia ambigua* var. *gracillima* B. L. Robinson appears to be only a local variation without clear morphological or geographical limits. I have seen it at the type-locality at Eau Gallie, Brevard County, Florida, (where the typical form has also been collected) and, with slightly broader leaves, near Estero, Lee County, on the other side of the peninsula.

The four pubescence-forms encountered in *Tephrosia onobrychoides* and *T. hispidula* occur sporadically nearly throughout the range of *T. florida* without showing definite geographical segregation. Three of the four types occur in the most northeasterly colony known (Carteret Co., N. C.) and the same three are found in the neighborhood of Miami, Florida, at the extreme south of the range of the species. I have, however, seen no herbarium specimens from Alabama and Louisiana (where I have no field-acquaintance with the species) with spreading pubescence, although plants with the leaflets either glabrous or pubescent above appear to occur together throughout the area. The absence of such plants in Alabama and Louisiana may well be more apparent than real.

Galega villosa Michx. of "Carolina ad Florida" usually has been interpreted as either *Tephrosia spicata* (Walt.) T. & G. or *T. chrysophylla* Pursh. Michaux's description is insufficiently definite to determine which of the several species of the southeastern United States he had. However, a photograph in the Gray Herbarium of the type-specimen in the Paris Museum clearly shows *Galega villosa* Michx. to be the present species. This name, *Galega villosa* Michx. (1803), is a later homonym of *G. villosa* L. (1753). In spite of this Persoon made combinations under his genus *Tephrosia* (1807) for both the Michaux and Linnaean names. Under these circumstances the combination *Tephrosia villosa* (L.) Pers., based on the valid name, should stand. This combination is currently used for an Asiatic plant which has been designated as the type-species of the conserved genus *Tephrosia.*

Dietrich in 1817 described *Galega florida,* apparently as a substitute for *G. villosa* Michx. His Latin description is identical

with that of Persoon's *T. villosa* which was abridged from Michaux's original brief description. Dietrich added a German translation of the Latin. There can be no doubt that *Galega florida* F. G. Dietr., as described, is synonymous with *G. villosa* Michx. The original description is as follows:

2. *Galega florida* Diet. Amerikanische Geisraute.

Tephrosia (villosa) prostrata villosissima, foliolis cuneato-obovalibus, spic. suboppositifoliis paucifloris, legum. oblongis. Mich. amer. 2. p. 68.

Der Stengel is auf der Erde hingestreckt und mit weichen Haaren dicht bekleidet; er trägt gefiederte Blätter, deren Blättchen keilförmig-oval sind, und wenigblümige Aehren, die den Blättern gegenüberstehen. Die Hülse ist länglich.

Vaterland: Nordamerika, Carolina und Florida.

Dietrich here properly supplied a new name for *G. villosa* Michx., a later homonym of *G. villosa* L., although he did not really indicate that this was his reason for doing so. He did, however, know of the earlier *G. villosa* L., for it is listed in his Vollst. Lexik. Gaertn. und Bot. **4:** 260. 1804, to which the above work is an addition. Later, however, in 1838 (in his Neuer Nachtr. Vollst. Lexik. Gaertn. und Bot. **8:** 553), after having accepted *Tephrosia* Pers., he placed his *G. florida* in the synonymy of *Tephrosia villosa* (L.) Pers., and placed *G. villosa* Michx. in that of *T. prostrata* Nutt., along with *T. chrysophylla* Pursh. From this later split it may be argued that Dietrich did not know what he was doing and that he did not intend to substitute the name *G. florida* for *G. villosa* Michx. However, since he obviously knew of the previous *G. villosa* L. and since he actually did supply a new name for *G. villosa* Michx., a later homonym, *Galega florida* F. G. Dietr. seems to be a perfectly valid name which it is necessary to use. Most unfortunately this old name must replace the well-known *Tephrosia ambigua* (M. A. Curtis) Chapm., but there appears to be no other alternative, now that *Galega villosa* Michx. is known to be this species.

19. **Tephrosia chrysophylla** Pursh

Tephrosia chrysophylla Pursh, Fl. Amer. Sept. **2:** 489. 1814. "Georgia, *Enslen.*"

Galega chrysophylla (Pursh) Steud. Nom. ed. 1. 350. 1821.

Cracca chrysophylla (Pursh) Kuntze, Rev. Gen. **1:** 174. 1891.

Tephrosia prostrata Nutt. Gen. N. Amer. Pl. **2:** 210. 1818. "Common around Savannah in Georgia in dry and sandy woods" (PH-Type).

Cracca chrysophylla Chapmanni Vail, Bull. Torr. Cl. **22:** 34. 1895. "St. Joseph's, Florida," [Pasco County], *Chapman*, (NY-Type; GH).

Tephrosia chrysophylla var. *Chapmanni* (Vail) B. L. Robinson, Bot. Gaz. **28:** 198. 1899.

Cracca Chapmanni (Vail) Small, Fl. Southeastern U. S. 612, 1331. 1903.

Cracca Carpenteri Rydb. N. Amer. Fl. **24:** 172. 1923. "Pine woods," Pensacola, Escambia County, Florida, *Dr. Carpenter 44*, June 1838 (NY-Type).

Tephrosia Carpenteri (Rydb.) Killip, Jour. Wash. Acad. Sci. **26:** 360. 1936, as *Carpinteri*.

Completely prostrate perennial herb from a woody crown and ligneous, cylindrical tap-root; stems one to several, branching sympodially, up to 1 m. long. Stems, petioles, rachises, petiolules and axes of the inflorescences strigillose or both hirtellous and hirsutulous or sparsely hirsute with rusty or cinereous hairs. Leaves prostrate, 1.2–6.5 cm. long, nearly sessile or with petioles up to 5 (rarely 7 mm.) long; stipules often persistent, lanceolate or linear-lanceolate, 2–6 mm. long; leaflets (3–)5–7(–9 or very rarely 11), cuneate, obovate-cuneate, or narrowly so, or occasionally obovate to nearly orbicular, mucronate, the terminal leaflet 8–30(–35) mm. long, 6–20 mm. wide, often conspicuously larger than the lateral, the lateral leaflets 7–28 mm. long, 4–15 mm. wide, somewhat coriaceous, shining when fresh, green, glabrous (or rarely finely hirtellous with golden-brown hairs) above, moderately to densely strigillose and short-strigose beneath with cinereous to golden-brown hairs, usually appearing silky. Inflorescences opposite the leaves (or terminal late in the season), 1.5–19 cm. long, exceeding the leaves, prostrate, slightly angled to somewhat flattened, leafless, bearing flowers at 1–8 nodes; buds 2–3 at a node, 1 or 2 of these flowering. Primary bracts lanceolate to subulate-lanceolate or occasionally ovate and obtuse, 2–6 mm. long, persistent. Pedicels 3–10 mm. long, ascending. Dried flowers 10–15 mm. long. Calyx hirtellous or strigillose or both hirtellous and hirsutulous with whitish or (on the lobes) bronzy hairs, 5–6 mm. long, the upper lobes lanceolate, acute or acuminate, 2.5–4 mm. long. Corolla white (the back of the banner pinkish or faintly lined with red), becoming pink and then carmine in age and purple upon drying; blade of the banner subquadrate or orbicular, 11–13 mm. high, 12–14 mm. broad, silky on the back, the claw 2.5 mm. long; wings 12–14 mm. long, auricled, the claw 1.5–2 mm. long; keel 9–13 mm. long, the claw 2–2.5 mm. long. Staminal tube 10–11 mm. long, the vexillary stamen completely free, without a distinct thickening on the upper side near the base. Ovary densely strigillose; ovules 9–13. Legume nearly straight, borne parallel to the surface of the ground, (2.2–)3.2–5.5 cm. long, 4–5.5 mm. wide, strigillose or hirtellous with antrorsely directed hairs; seeds 6–13, subspherical, 2.4–3 mm. in diameter, brown mottled with black. Somatic chromosomes 22. Flowering collections from mid-May through September.

DISTRIBUTION. Prostrate on well-drained, sandy soils usually in full

sun in open oak and pine woods, Chatham (where not recently collected) and Charlton Counties, Georgia, south to Highlands and Lee Counties, Florida, and west to Harrison County, Mississippi, United States. Map 12.

Specimens examined. UNITED STATES. Georgia. *Dr. Boykin* (NY); inter frutices in arenosis, *Beyrich 161* (MO, NY). Chatham Co.: Savannah, *John Forbes* (NY), *Nuttall* (PH). Charlton Co.: between Spanish Creek and Traders Hill, *Harper 1497* (GH, NY, US). Florida. *Buckley* (GH, MO, NY); *Chapman* (GH, MO, NY, US); *Torrey & Gray* (GH); *Nash 553, 753* (NY). Alachua Co.: *Hitchcock*, 1898 (MO); near Gainesville, *Murrill*, 1939 (DUKE), *West 5* (FLAS); High Springs, *Wood & Clement 7534* (GH). Bay Co.: Lynn Haven, *Billington*, 1921 (US). Bradford Co.: 10 mi. south of Starke, *Dennison & Arnold*, 1946 (FLAS). Brevard Co.: Indian River City, *Wood & Clement 7196* (GH). Citrus Co.: 3 mi. s.s.w. of Inverness, *Wood & Clement 7525a* (GH); 11 mi. n.e. of Red Level, *West & Arnold*, 1941 (FLAS). Clay Co.: Green Cove Springs, *Wood & Clement 7151* (GH); Gold Head Branch State Park, *West*, 1939 (FLAS). Dixie Co.: 2 mi. south of Shamrock, *Erlanson 243* (US); 10 mi. west of Shamrock, *Pasture Survey*, 1937 (FLAS). Duval Co.: South Arlington, *Lighthipe 608* (NY); *Pieters 53* (GH), *44* (US); *Curtiss*, 1876 (US); Jacksonville, *Curtiss 582* (CAS, GH, MO, NY, PH, UC, US), *2825* (US), *4229* (DS, NY, UC, US), *4824* (GH, NY, UC, US), *Fredholm 225* (POM); 2 mi. south of Nassau Co. line on U. S. Route 17, *Wood & Clement 7146* (DUKE). Escambia Co.: Pensacola, *Carpenter 44* (NY). Franklin Co.: Apalachicola, *Chapman* (MO). Hernando Co.: Highway 41 near Citrus Co. boundary, *Wood & Clement 7524* (GH); hillside near Chisegut Hill Bird Sanctuary, 3 mi. south of Citrus Co. line on route 41, *Wood & Clement 7521* (GH). Highlands Co.: Avon Park, *Buswell*, 1936 (MIAMI); Sebring, *Small & West*, 1934 (FLAS); Lake Jackson, Sebring, *McFarlin 8114* (NY). Hillsborough Co.: 1 mi. south of Riverview, *Wood & Clement 7514* (GH); Tampa, *Henshall* (F), *Ferguson*, 1898 (MO), *Garber*, 1877 (GH, PH, US), 1876 (NY, US), *Britton & Wilson 12* (NY); Long Island, Tampa Bay, *Rugel*, 1845 (NY). Holmers Co.: Ponce de Leon, *Knight*, 1944 (FLAS). Lake Co.: Astor Park, *Wood & Clement 7176* (GH); Eustis, *Gandoger*, 1900 (MO), *Nash 811* (GH, MO, NY, UC, US), *1964* (NY, US), *Hitchcock*, 1894 (F, FLAS, KSC, MO). Lee Co.: Myers, *Hitchcock 81* (GH, MO, NY, US). Levy Co.: 2 mi. south of Lebanon Station, *Pasture Survey*, 1937 (FLAS). Liberty Co.: Bristol, *Chapman* (MO, US); just north of Bristol, *West & Arnold*, 1940 (FLAS); Roy, *Wiegand & Manning 1554* (GH). Madison Co.: *Hitchcock*, 1898 (F, MO). Marion Co.: 3 mi. south of Orange Springs, *West & Arnold*, 1942 (FLAS); 16 mi. south of Ocala, *Erlanson 249* (GH, US); 20 mi. south of Gainesville, *Erlanson 244* (GH, UC-part). Orange Co.: *Buswell*, 1932 (MIAMI); *Fredholm 5364* (GH); Lake Brantley, *Lewton*, 1894 (NY); Clarcona, *Pieters 53* (US), *Meislahn 141* (US); south of Wekiva Springs, *Moldenke 5359* (NY); west of Bithlo on Route 50, *Wood & Clement 7192* (GH); Orlando, *Davis*, 1934 (FLAS); just south of Tangerine, *Wood & Clement*

7189 (GH). Pasco Co.: St. Joseph, *Chapman* (GH, NY); 15 mi. s.s.w. of Brooksville (Hernando Co.), *Wood & Clement 7520* (GH). Polk Co.: *Schallert 16503* (NY, US); Lake Alfred, *Bottimer 497* (US). Putnam Co.: Johnson, *Barnhart 1275* (NY); 3 mi. south of Clay Co. line on U. S. Route 17, *Wood & Clement 7169* (GH); Welaka, *Laessle*, 1940 (FLAS). Santa Rosa Co.: Choctawahatchee National Forest, east of Milton, *Erlanson 216* (US). Suwanee Co.: 5 mi. west of O'Brien, *Arnold & West*, 1946 (FLAS). Volusia Co.: 6 mi. south of New Smyrna, *Butts & Ames 528* (GH).

Alabama. Baldwin Co.: Tensaw, *Tracy 8014* (GH, NY). Mobile Co.: Mobile?, *Mohr* (F); Mobile, *Baker*, 1897 (KSC, MO, NY); 16 mi. north of Mobile, *Erlanson 183* (US); 2 mi. north of Citronella, *Erlanson 202* (US); Spring Hill, *Mohr*, 1897 (US), *Bush 298* (NY, US). Mississippi. Harrison Co.: Beauvoir, *Tracy 4911* (GH, MO, NY, US); Bond's Point, *Tracy 4437* (US); west of bay, Biloxi, *Pennell W4389* (PENN); 1 mi. east of Mississippi City, *Pennell 4354* (NY, PENN).

Tephrosia chrysophylla is a characteristic species of open, well-drained, sandy soils of Florida. The completely prostrate habit, combined with the few, usually cuneate or obovate leaflets and the very short petioles, is distinctive.

Plants smaller than normal in varying degrees have received specific names for which there seems no justification. Those with leaflets 1–1.5 cm. long are *Cracca Carpenteri* Rydb., but such plants occur in peninsular Florida with the ordinary type, the leaflets of which are 0.8–3 cm. long. *Cracca Chapmanni* (Vail) Small is known only from two specimens collected by Chapman. These plants are reduced in size in all their parts, but are particularly conspicuous in their small leaflets, 5–15 mm. long, and their pods, 2 cm. long and 3–4 mm. wide. Since these specimens were collected well within the range of *T. chrysophylla* and since they differ only in size, they should be regarded, in the absence of other evidence, merely as a form of the species. Chapman (as many another botanist of his time and later) seems to have taken a particular interest in collecting aberrant forms and many peculiar and fragmentary plants are represented in his collections.

The three collections cited from Highlands County, Florida, need further investigation. These are atypical in that the upper surfaces of the leaflets are hirtellous, while the leaflet-number varies from five to eleven. The leaflets are somewhat smaller and more uniform in size than is usual in *Tephrosia chrysophylla* and the plants themselves are slightly reminiscent of *T.*

Rugelii, although the habit is evidently prostrate. Coming from the southern edge of the range of *T. chrysophylla* but within the area of *T. Rugelii* as they do, these specimens suggest the interesting possibility of hybridization of these two species.

19a. **Tephrosia chrysophylla** × **Tephrosia florida**

Cracca intermedia Small, Bull. Torr. Cl. **21:** 303. 1894. "Near Jacksonville," Duval County, Florida, *A. H. Curtiss 4231*, 31 May, 11 July 1893 (NY-Type; DS, UC, US).

Cracca Smallii Vail, Bull. Torr. Cl. **22:** 33. 1895. Illegitimate; substituted for *C. intermedia* because of *Tephrosia intermedia* Graham, 1828, a name which had never been transferred to *Cracca*.

Tephrosia Smallii Robinson, Bot. Gaz. **28:** 198. 1899, as comb. nov., but a new name based on *Cracca intermedia* Small, not *Tephrosia intermedia* Graham, 1828.

Cracca floridana Vail, Bull. Torr. Cl. **22:** 35. 1895. "Central Florida," *G. V. Nash 494½, 1198, 1263, 1334, 1552, 1615*, (probably all collected in the vicinity of Eustis, Lake County, Florida); *1552*, vicinity of Eustis, 1–15 August 1894 (NY-Cotypes; *1552*-GH, MO, UC, US).

Intermediate between *Tephrosia chrysophylla* and *T. florida*. Perennial from a woody crown and brown cylindrical woody tap-root; stems prostrate, branching sympodially, spreading, leafy from the base, generally terete. Stems, petioles, rachises, petiolules and axes of the inflorescences hirtellous, strigillose or hirtellous and hirsutulous with brown or cinereous hairs. Leaves usually ascending, but sometimes prostrate, or rarely erect, 5–10 cm. long, the petioles of the principal leaves 5–19 mm. long, (1/5–) 1/3–7/9 of the length of the lowermost leaflets (including petiolules) of a leaf, some or all more than 1/3 the length of the lowermost leaflets; stipules lanceolate to linear, acute or acuminate, 2–8 mm. long, up to 2 mm. wide, persistent; leaflets of the principal leaves 7–11(–13), averaging 9, cuneate to oblong-obovate to narrowly elliptic, the apex rounded to retuse, mucronate, the terminal leaflet 16–32 mm. long, 7–19 mm. wide, the lateral leaflets 12–28 mm. long, 5–14 mm. wide, the lowermost usually smallest, the leaflets of living plants dull, with the texture of *T. florida*, lacking the luster of *T. chrysophylla*, glabrous (or very rarely hirtellous) above, moderately strigillose or strigillose and short-strigose or rarely hirtellous beneath, not sericeous. Inflorescences opposite the leaves, generally exceeding them, 6–22 cm. long, prostrate or occasionally slightly assurgent, leafless, bearing flowers at 1–6 nodes, the peduncle strongly flattened and 2-edged as in *T. florida*, especially below the first node; buds 2 or 3 at a node, 1 or 2 of these flowering. Primary bracts persistent, that of the first node 2–5 mm. long, decreasing in size at the upper nodes. Dried flowers 10–15 mm. long. Calyx 3.5–4 mm. long, intermediate between or resembling either parent, more often *T. florida*. Corolla white, as in the parents; blade of the banner 13 mm. high, 11 mm. wide; wings about 13

mm. long with a blunt auricle on the upper side. Legume straight or slightly curved downward, hirtellous or strigillose with cinereous hairs, few of the ovules developing, the seeds 2–5; mature seeds not seen.

DISTRIBUTION. Open, well-drained sandy soils occupied by both presumed parents in Georgia, Florida and Alabama, United States.

SPECIMENS EXAMINED. UNITED STATES. GEORGIA. Without locality, *Dr. Boykin* (NY). FLORIDA. Without locality, *Chapman* (GH, MO, NY, OKL); *Nash 1334* (NY). Duval Co.: near Jacksonville, *Curtiss*, 31 May 1893 (MO), *Curtiss 4231*, 31 May, 11 July 1893 (DS, NY, UC, US); oak scrubs in dry pine barrens, *Curtiss 4825*, 31 July 1894 (FLAS, GH, MO, NY, UC). Franklin Co.: dry sand ridges, Apalachicola, *Saurman*, 1867 (F, PENN). Hernando Co.: white sand in long-leaf pine and *Quercus laevis* woods on hill on Highway 41 near the Citrus Co. boundary, *Wood & Clement 7523*, 9 Aug. 1947 (FLAS, GH). Hillsborough Co.: white sand in openings in *Quercus virginiana* woods, 1 mi. south of Riverview, *Wood & Clement 7515*, 8 Aug. 1947 (GH). Lake Co.: vicinity of Eustis, *Nash 1552*, 1–15 Aug. 1894 (GH, MO, UC, US); probably in the vicinity of Eustis, *Nash 494½, 1198, 1263, 1615* (NY); vicinity of Eustis, *Hitchcock*, June–July 1894 (F). Marion Co.: in oak-scrub palmetto-flats, *Erlanson 244* (part), 28 May 1935 (UC). ALABAMA. Mobile Co.: Spring Hill, *Bush 296*, 1 Aug. 1897 (NY-part, US), *92*, 3 Aug. 1897 (US); Spring Hill, *Mohr*, 18 May 1896, 1897 (US); under scrub-oak and long-leaf pine, 18 mi. north of Mobile, *Erlanson 190*, 24 May 1935 (US).

Although Small pointed out in the description of *Cracca intermedia* that his "species" was intermediate between *C. ambigua* (*T. florida*) and *C. chrysophylla* (*T. chrysophylla*), the possibility of a hybrid origin of this plant does not appear to have been suggested. In the summer of 1947, however, plants strikingly intermediate between *Tephrosia florida* and *T. chrysophylla* and very like the type-collection of *Cracca intermedia* were found in two localities in peninsular Florida growing with the presumed parents. In both instances, only these two species of *Tephrosia* were present, along with relatively few plants of the putative hybrid. The intermediate nature of these plants and other presumed hybrids is indicated in the accompanying table.

Since "*Cracca intermedia*" occurs with both *T. chrysophylla* and *T. florida* in the absence of other species, since it occurs sporadically and only within the overlapping ranges of both species, and since it is morphologically intermediate between the two species, it seems safe to postulate the hybrid-character of these plants even in the absence of experimental evidence.

Cracca floridana Vail supposedly differed from *C. intermedia* in

T. florida	*C. intermedia*	*T. chrysophylla*
Stems prostrate, leaves erect.	Stems prostrate, leaves usually ascending at an angle, occasionally prostrate or erect.	Entire plant completely prostrate.
Leaflets 7–*13*–19, thin, dull.	Leaflets 7–*9*–11(–13), thin, dull.	Leaflets 3–*7*–9, somewhat coriaceous, shining.
Leaflets narrowly cuneate to narrowly oblong-cuneate, narrowly elliptic or linear-elliptic.	Leaflets cuneate to oblong-obovate or narrowly elliptic.	Leaflets cuneate, obovate-cuneate, or oblong-obovate, occasionally obovate to nearly orbicular.
Terminal leaflet 18–52 mm. long, 5–13 mm. wide; lateral leaflets 12–45 mm. long, 2–18 mm. wide.	Terminal leaflet 16–32 mm. long, 12–28 mm. wide; lateral leaflets 12–28 mm. long, 5–14 mm. wide.	Terminal leaflet 8–30 mm. long, 6–20 mm. wide; lateral leaflets 7–28 mm. long, 4–15 mm. wide.
Petioles 1–4 times the length of the lowermost leaflets of the leaves.	Petioles usually 1/3–7/9 of the length of the lowermost leaflets.	Petioles usually very short, less than 1/3 the length of the lowermost leaflets.
Axes of inflorescences strongly flattened, 2-edged, assurgent.	Axes of inflorescences flattened, 2-edged, prostrate or somewhat assurgent.	Axes of inflorescences sometimes slightly flattened, always prostrate.
Calyx 3–4.5 mm. long.	Calyx 3.5–4 mm. long, intermediate in shape or resembling *T. florida*.	Calyx 5–6 mm. long.

its assurgent habit, but Robinson (1899, p. 193) pointed out that the evidence is all to the contrary and concluded that *C. intermedia* and *C. floridana* represent variations of the same entity. In this he seems thoroughly justified. Miss Vail may have been misled by a Louisiana collection, "New Orleans, Dr. Ingalls," (NY), cited by her as one of the cotypes. This plant is the erect form of *Tephrosia florida* and not the plant under discussion here. If *Cracca floridana* is considered to be synonymous with *Cracca intermedia*, whoever desires to apply a "specific" name to these plants must make the proper combination under *Tephrosia* with *Cracca floridana* Vail as the basonym. *Nash 1552* would be the appropriate Type; the other cotypes are apparently represented only at NY. There would appear, however, to be little justification for applying a specific name to a hybrid of this kind.

It seems likely that the isolating mechanism between *Tephrosia chrysophylla* and *T. florida* is at least partially ecological.

Ordinarily *T. chrysophylla* seems to tolerate considerably drier, hotter and more open situations (particularly in oak-barrens where it usually occurs prostrate in openings on the white sand) than does *T. florida*. The latter species occurs more often in somewhat grassier and more shaded situations, which are probably also slightly moister. Occasionally, however, the two occur together, as at the localities cited in Hillsborough and Hernando Counties, Florida, and it is in areas such as these that the putative hybrids are found.

A second hybrid of *Tephrosia chrysophylla* is apparently represented by collections from Astor Park, Lake County, Florida. Here perfectly typical *T. chrysophylla* (*Wood & Clement 7176*) grew on the open white sand of a road embankment and *T. spicata* (*Wood & Clement 7178*) a few feet away at the edge of brush in a live-oak and saw-palmetto woods. Various scattered plants collected along the roadway combined characteristics of both of these species. One of these (*7181a*) had prostrate leaves with 7–9 (primarily 9) leaflets of intermediate shape with the pubescence of *T. chrysophylla* and the ascending inflorescences of *T. spicata* (those of *T. chrysophylla* are always borne parallel to the surface of the ground). Another plant (*7180b*) resembled *T. chrysophylla* still more, but bore 7–9 leaflets and inflorescences which were either prostrate or ascending at the tip. Five plants were found with prostrate leaves, bearing 5–11 leaflets (mostly 7–9) of intermediate shape, with the upper surfaces of the leaflets hairy and the inflorescences strongly ascending. All of these specimens seem to indicate various combinations of the characters of both *T. chrysophylla* and *T. spicata* and suggest repeated hybridization at this locality. Here again it may be noted that these two species do not ordinarily occur in the same habitat and that this may be an example of the breakdown of an ecological barrier through the agency of man.

20. **Tephrosia tepicana** Standl.

Cracca tepicana Standl. Contr. U. S. Nat. Herb. **20:** 217. 1919. Tepic, Nayarit, Mexico, *Edward Palmer*, 5 Jan.–6 Feb. 1892 (US 305316-Type).

Tephrosia tepicana Standl. Field Mus. Publ. Bot. **4:** 214. 1929.

Decumbent herbaceous or suffrutescent perennial; stems slender, ca. 2 mm. in diameter, flexuous, nearly terete near the base, often acutely angled above and almost triangular. Stems, petioles, rachises and petiolules thinly hirsutulous, hirtellous or strigillose with whitish hairs, or

nearly glabrous. Leaves apparently either prostrate or ascending, 6–16 cm. long, the petioles 1–35 mm. long, shorter than the leaflets of the lowermost pair, the rachis (0.7–)2–10 cm. long; stipules subulate or linear, long-acuminate, 3–13 mm. long, less than 1 mm. wide, brown, persistent, ascending; leaflets of the principal leaves 5–11, elliptic-oblong, elliptic or oval-oblong to lanceolate or elliptic-lanceolate, the upper leaflets largest, 30–59 mm. long, 13–30 mm. wide, the lowermost pair smallest, (12–)20–55 mm. long, (8–)12–23 mm. wide, the leaflets rounded or subcordate at the base, the apex retuse, obtuse or acute, mucronate; leaflets thin but rigid, with the midrib impressed, green, dull or somewhat shining, thinly strigillose to hirtellous and glabrate above, thinly hirtellous to strigillose below with whitish hairs 0.2–0.6 mm. long, or short-strigose to hirsutulous along the midrib, the margins undulate, sometimes subcrenate, ciliate with cinereous hairs ca. 1 mm. long, these often deciduous; petiolules 1.5–2.5 mm. long. Inflorescences terminal or axillary, probably sometimes appearing to be opposite the leaves, leafless, ascending, slender, (2–)4–22 cm. long, the peduncle (1.5–)2.5–9 cm. long, the axis of the inflorescence thinly strigillose to nearly glabrous, usually flattened and 2-edged, few-flowered, the (3–)5–18 flowering nodes often crowded distally; buds 3–5 at a node, 2–3 of these flowering. Primary bracts linear-subulate, 3–9 mm. long, persistent, brown; secondary bracts linear-setaceous, 1–4 mm. long. Pedicels 4–7 mm. long, slender, ascending. Dried flowers ca. (12–) 15 mm. long. Calyx 4.5–5 mm. long, strigillose to hirtellous, the lobes deltoid or deltoid-ovate, abruptly short-acuminate, the upper lobes 1.5–2 mm. long, the lateral 2 or 3 mm. long, the lowermost ca. 2 mm. long. Flower-color unknown, brown or purplish in dried specimens; blade of the banner apparently oval, ca. 11 mm. high, 16 mm. broad, strigillose on the back with fine silky golden hairs, the claw ca. 3 mm. long; wings 13–15 mm. long, 4–5 mm. wide, slightly auricled, the claw 2 mm. long; keel 14–15 mm. long, 6 mm. deep, rounded at the apex, slightly auriculate at the base, the claw ca. 3 mm. long. Staminal tube 9–10 mm. long, the vexillary stamen lightly coherent with the staminal tube or free, somewhat thickened on the upper side near the base. Ovary densely strigillose, silky. Nearly mature pod almost straight, with a slightly down-curved beak, ca. 6 cm. long, 6 mm. wide, hirtellous to strigillose with cinereous hairs 0.2–0.4 mm. long; seeds 10 or 11, the mature seeds unknown. Flowering collections January to February.

Distribution. Southern Sinaloa and Nayarit, Mexico. Map 24.

Specimens examined. MEXICO. Sinaloa: Vicinity of Balboa, Municipalidad San Ignacio, *J. G. Ortega 1209* (MEXU); Balboa, *Ortega 5104*, Jan. 1925 (US); Mazatlán, *Ortega 5081*, Jan. 1923 (US). Nayarit: Tepic, *Palmer*, 5 Jan.–6 Feb. 1892 (US).

Tephrosia tepicana is easily recognized by habit, leaflet-number and -shape, and calyx. The vexillary stamen appears to be free from the staminal tube, but the present paucity of flowering

material leaves this in doubt. This little-collected species appears to be related to *Tephrosia madrensis* which is known from a single collection, presumably from the Sierra Madre of this same region.

21. **Tephrosia madrensis** Seem.

Tephrosia madrensis Seem. Bot. Voy. Herald 280. pl. 61. 1856. "Sierra Madre, Mexico" (between the cities of Mazatlán and Durango or Durango and Tepic in Sinaloa, Durango or Nayarit), *Seemann 2186*, Nov. 1849–Feb. 1850 (K-Type).

Cracca madrensis (Seem.) Kuntze, Rev. Gen. **1:** 175. 1891, basonym misattributed to Benth.

Galactia marginalis Seem. Bot. Voy. Herald pl. 61. 1856, not Benth.

Decumbent, suffruticose perennial; stems prostrate, about 2 dm. long from a slender woody crown, nearly terete below, 2 mm. in diameter, angular above. Stems, petioles, petiolules, stipules and axes of the inflorescences thinly strigillose with cinereous hairs or nearly glabrous. Leaves unifoliolate, the petioles (5–)7–15 mm. long; stipules linear, acuminate, 5–10 mm. long, persistent, brown; leaflets elliptic or oblong-elliptic, acute, obtuse or rounded at apex and base, mucronate, the principal leaflets 25–50 mm. long, 12–23 mm. wide, thin but coriaceous, glabrous above or with a few short appressed hairs along the midrib and lateral veins, the veins prominent, reticulate, the leaflets paler below, sparsely strigillose with cinereous hairs 0.2–0.4 mm. long; petiolules 1–2 mm. long. Inflorescences terminal and axillary, the terminal leafless, 9–10 cm. long, the peduncle 1.5–3.5 cm. long, one inflorescence with a short lateral branch from the lowermost node; axillary inflorescences short, 2–3 cm. long, with a single leaf; axes of the inflorescences stiff, flattened (1.5–2 mm. wide) below the 2–9 flowering nodes, 2-edged, the terminal inflorescence exceeding the leaves; buds ca. 5 at a node, probably 2 or 3 of these flowering. Primary bracts lanceolate or linear-lanceolate, acuminate, 5–10 mm. long, rigid, brown, persistent; secondary bracts linear, acuminate or subulate, 3–5 mm. long, persistent. Pedicels 9–11 mm. long, slender, ascending. Dried flowers about 15 mm. long. Calyx campanulate, 3.5–5 mm. long, thinly strigillose with rusty and cinereous hairs, the tube 2–2.5 mm. long, the upper lobes subulate, 1–2.5 mm. long, the lateral and lowermost triangular-lanceolate, acuminate, 1.5–3 mm. long. Flower-color unknown, the dried flowers brown; blade of the banner suborbicular, ca. 12 mm. in diameter, retuse, strigillose on the back with silky brownish hairs; wings ca. 14 mm. long, auricled; keel ca. 13–14 mm. long, exauriculate. Staminal tube ca. 8.5–11 mm. long. Ovary strigillose along the sutures, the valves nearly glabrous; ovules ca. 6. Mature fruit and seeds unknown; young legume sparsely strigillose on the valves, strigillose along both sutures with minute hairs 0.2 mm. long.

Distribution. Known only from the type-locality.

Specimen examined. MEXICO. Sinaloa, Durango or Nayarit:

"Sierra Madre" (between the cities of Mazatlán and Durango or Durango and Tepic), *Seemann 2186*, Nov. 1849–Feb. 1850 (K).

The nearly glabrous, thin but rigid, unifoliolate leaves are characteristic. If the mature pod, when collected, proves to be glabrous, it will supply an additional conspicuous character. *Tephrosia madrensis* appears to be most closely related to *T. tepicana* and to an undescribed species from Guatemala represented by *Steyermark 51790* (F) (see Standley & Steyermark 1946, p. 356).

22. **Tephrosia Lindheimeri** A. Gray

Tephrosia Lindheimeri A. Gray, Bost. Jour. Nat. Hist. **6:** 172. 1850. "Muskit prairies, on the Liano," [Llano County?], Texas, *Lindheimer Distrib. No. 592*, Aug. 1847 or 1848 (GH-Type; MO, NY, US).

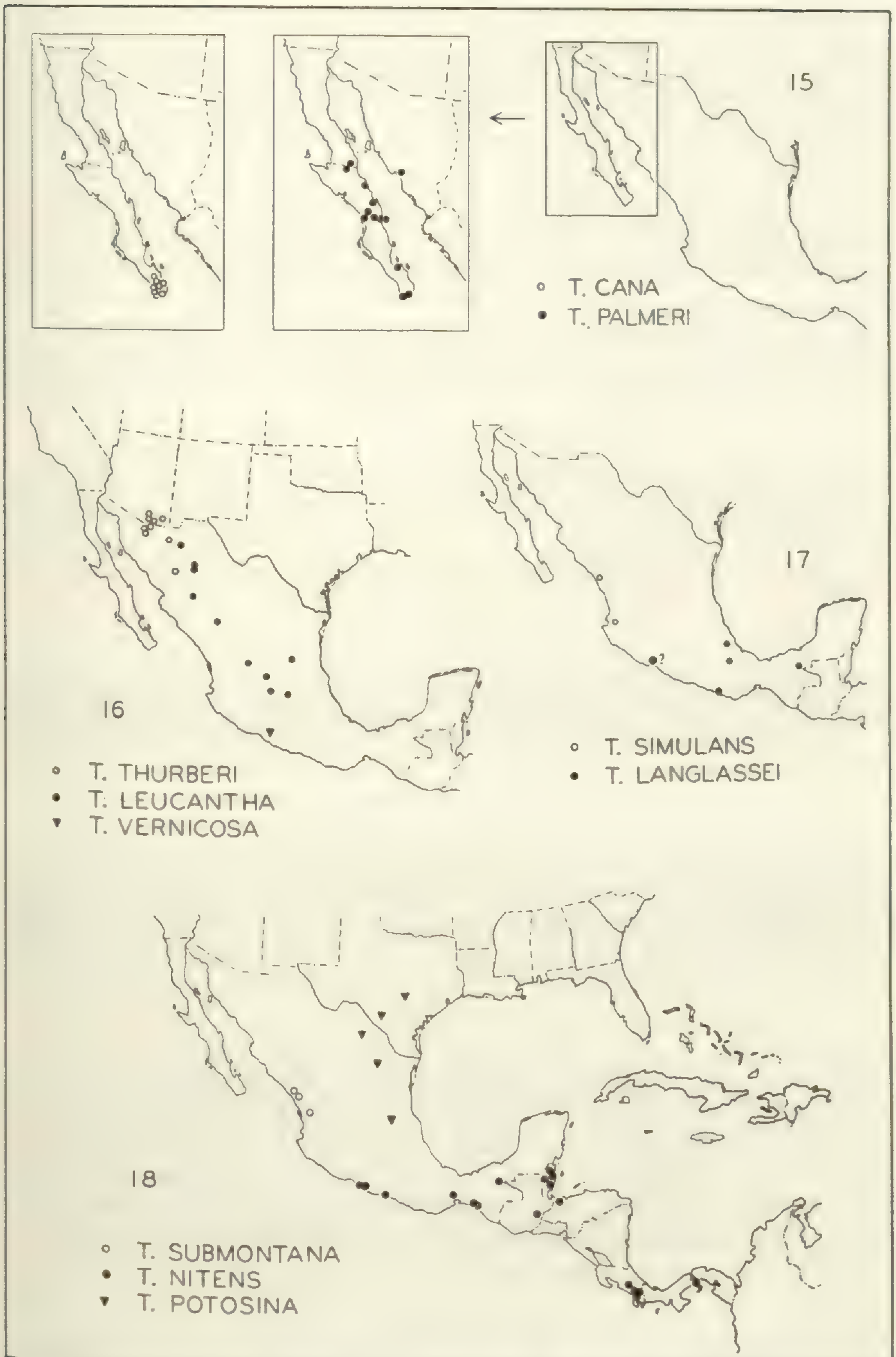
Cracca Lindheimeri (A. Gray) Kuntze, Rev. Gen. **1:** 175. 1891.

Prostrate or decumbent perennial herb from a woody crown and woody cylindrical tap-root (–1.5 cm. thick); stems several, up to 1 m. long, somewhat flexuous, branching sympodially or partially so, terete or angled. Stems, petioles, rachises and peduncles of the inflorescences hirtellous to hirsutulous with soft dense whitish ascending or spreading hairs. Leaves 5–15(–20) cm. long, ascending; petioles (1.6–)2.5–4.5 cm. long, shorter or (more often) longer than the lowermost leaflets of a leaf; stipules linear, acuminate, 12 mm. or less long, striate, becoming brown, often deciduous; leaflets of the principal leaves (5–)7–15(–19), mostly 9–11, obovate to broadly obovate-cuneate, or nearly orbicular or elliptic, the apex obtuse, retuse or emarginate with a slender mucro, (11–)18–33(–37) mm. long, (7–)12–21(–27) mm. broad; leaflets thin but somewhat rigid, dull, grayish-green, densely strigillose to short-strigose or hirtellous to hirsutulous with white hairs to nearly glabrous with but a few appressed hairs around the margins above, moderately to densely hirtellous to hirsutulous with fine ascending hairs below, appearing hoary or silky, the margins of the leaflets conspicuously bordered with short white antrorsely directed hairs, the veins conspicuous, pale to brownish beneath; petiolules 1–3 mm. long. Inflorescences terminal, either opposite the leaves or at the ends of axillary branches which may overtop the primary branches, 7–30 cm. long, ascending to erect, leafless, the flowering nodes 3–18; buds 4 or 5 at a node, 2 or 3 flowering and fruiting. Primary bracts lanceolate, long-acuminate, to linear-lanceolate, 8–10 mm. or less long, inconspicuous, deciduous, falling soon after anthesis; secondary bracts linear-lanceolate, 2–4 mm. long, deciduous. Pedicels slender, becoming stout in fruit, (4–)5–9 mm. long, ascending. Dried flowers 13–15 mm. long. Calyx 5–6 mm. long, hirsutulous with soft white hairs, the upper lobes deltoid, short-acuminate, 2–3 mm. long, the lateral lobes deltoid-lanceolate, acute, 3–4 mm. long, the lowermost lobe lanceolate, acuminate, keel-like, 4–6 mm. long. Corolla rose-purple, the banner with a white spot near the base of the

blade; blade of the banner suborbicular to rounded-quadrate, 11–13 mm. high, 12–15 mm. broad, hirtellous to hirsutulous with white hairs on the back, the claw 3 mm. long; wings 10–15 mm. long, with a small deltoid auricle, the claw 3 mm. long; keel 13–15 mm. long, with or without an auricle, the claw 3–3.5 mm. long. Staminal tube 10–11 mm. long, the vexillary stamen coherent with the tube along the middle third, flat, without an angular callosity on the upper side near the base. Ovary densely silky, hirtellous or strigillose; ovules 5–6. Legume shaped roughly like a long parallelogram, somewhat curved and narrowed near the base, (2.5–)4–5 cm. long, 7–8.5 mm. broad, horizontal or ascending, stramineous, moderately to densely hirtellous with soft white hairs, appearing velutinous; seeds (1–)4–6, oblong to suborbicular in outline, the ends often flattened by crowding, plump or flat, 5–7 mm. long, 4–5 mm. wide, stramineous to dirty tan, unmarked. Somatic chromosomes 22. Flowering collections from early April to September.

Distribution. Well-drained sandy, decomposed granite or limestone soils, roadsides, grassy areas and open oak woods or mesquite stands, southern Texas from Burnet and Llano Counties to Harris, Zavala and Cameron Counties and perhaps (?) with an isolated station in Cooke County. Map 14.

Specimens examined. UNITED STATES. Texas. Without definite locality: *C. Wright* (GH, NY, US); *Nealey*, 1888 (DS); *Wilkinson 177* (MO); from Bexar to the Rio Grande, *Berlandier 958* (MO), *2388* (GH, MO), *3133* (GH, MO, NY, US). Aransas Co.: Rockport, *Shulz*, 1938 (F). Bexar Co.: Applewhite Road, 18 mi. south of San Antonio, *Sister Mary Metz 626* (NY); San Antonio (TEX); s.w. of San Antonio, *Tharp*, 1926 (TEX); 15 mi. south of San Antonio, *Shulz 439* (US). Burnet Co.: Granite Mt. (DS, MO); granite region of Burnet, *Reverchon 1664* (MO); Burnet, *Fisher 3626* (CAS, US); s.e. corner of Burnet Co., *Hill 27* (US). Cameron Co.: *Bailey 242* (US). Comal Co.: New Braunfels, *Dapprich 6861* (SMU). Cook Co.?: Gainesville (county not indicated on label) (this station omitted from map), *E. Russell*, 1933 (UC). Dimmit Co.: Carrizo Springs, *Hoglund*, 1930 (TEX); east of Carrizo Springs, *M. E. Jones 28558* (DS, GH, MO, POM, UC, US). Duval Co.; Peña Station, *Havard*, 1884 (F, GH). Frio Co.: 14 mi. south of Pearsall, *Shreve 9445* (GH); Dilley, *Innes & Moon 1310* (GH, MO, TEX); Dilley, *Reverchon*, 1905 (OKL); along highway just n.e. of Dilley on Route 81, *Moore & Wood 3617* (GH, UC, Bailey Hortorium); sandy upland in open mesquite stand near semi-permanent pool, *Wolcott & Barkley*, 1946 (MO, PENN, TEX). Gonzales Co.: *Bogush 1305* (GH, TEX); *Normand*, 31 May 1929 (TEX, UC); 5 mi. n.w. of Westoff, *Muller 8016* (SMU); *Bogush*, 1926 (NY), *1305* (US); Ottine, *Cory 5709* (GH, POM). Guadalupe Co.: ca. 10 mi. south of Seguin, *Webster & Rowell 7095* (TEX); 13 mi. south of Seguin, *Wolcott & Barkley 16T435* (TEX); in limestone soil, Seguin, *Groth 181* (CAS, F, GH, NY, US). Harris Co.: open woods near the San Jacinto River, east of Houston, *Small & Wherry 11805* (NY). Hidalgo Co.; Rio Grande Valley, *M.*


15
T. CANA
T. PALMERI
16
T. THURBERI
T. LEUCANTHA
T. VERNICOSA
17
T. SIMULANS
T. LANGLASSEI
18
T. SUBMONTANA
T. NITENS
T. POTOSINA

Walker 71 (TEX, UC). Kleberg Co.: Kingsville, *Sinclair*, 1940 (TEX). LaSalle Co.: near Cotula, *Perkins & Hall 2323* (POM); Millett, *Trelease*, 1897 (MO). Llano Co.: between Enchanted Rock and Llano, *Tharp*, 1936 (GH, SMU, UC); near Enchanted Rock, *Whitehouse*, 1930 (TEX). Llano Co.?: "muskit prairies on the Llano," *Lindheimer 592* (GH, NY, MO, US), Oct. 1847 (GH, MO). Webb Co.: Laredo, *E. Palmer 258*, 1879 (GH), *250*, 1880 (US). Willacy Co.: along roadside, north of Raymondville, *Clover 1198* (NY). Wilson Co.: Wisdom Ranch, 20 mi. east of San Antonio, *Cutler 3225* (MO); Kicaster School, *Parks R2328* (MO); along San Antonio Highway at Wilson-Bexar County line, *Drushel 9857* (NY, US); 7 mi. n.w. of La Pryor, *Hedrick 272* (UC).

Tephrosia Lindheimeri is discussed with the following species.

23. **Tephrosia potosina** Brandeg.

Tephrosia potosina Brandeg. Univ. Calif. Publ. Bot. **4:** 272. 1912. Near Rascón, San Luis Potosí, Mexico, *C. A. Purpus 5273* (UC-Type; GH, MEXU, MO, NY, US).

Cracca potosina (Brandeg.) Standl. Contr. U. S. Nat. Herb. **23:** 472. 1922.

Decumbent perennial herb from a slender woody crown and heavy woody tap-root 1.5 cm. thick; stems 1 to several, sympodial or partially so, somewhat flexuous, slender (–2.5 mm. thick), up to 5 dm. long, axillary branches often poorly developed. Stems, petioles, rachises and peduncles of the inflorescences hirsutulous with spreading, often somewhat retrorse, tawny, rusty or sordid hairs. Leaves 7–22 cm. long, ascending; petioles (1.5–)2.5–10 cm. long, longer than the lowermost leaflets; leaflets 3–9, predominantly 5–7, obovate to broadly obovate-cuneate or orbicular, the apex obtuse or retuse, mucronate, 1–5 cm. long, 0.7–4(–4.5) cm. wide, dull, bluish-green, rigid but not coriaceous, completely glabrous above, moderately to very densely hirsutulous with ascending to spreading cinereous to tawny hairs, sometimes appearing pilose or silky, the margins of the leaflets bordered with usually inconspicuous tawny to rusty antrorsely directed hairs, the veins pale to reddish beneath. Inflorescences terminating either the main or axillary branches, erect or ascending, up to 27 cm. long. Dried flowers 13–20 mm. long; flower-dimensions as in *T. Lindheimeri;* corolla rose-purple with a green spot at the base of the blade of the banner. Pedicels, calyx and back of the banner usually hirsutulous with golden or rusty hairs. Ovules 4–8. Legume 2–5.5 cm. long, 6–8 mm. wide, stramineous to dirty brown, hirtellous with tawny, rusty or tan hairs; seeds (1–)4–8, suborbicular to subquadrate in outline, the ends sometimes flattened by crowding, plump, 4.5–5.5 mm. long, 4–5 mm. wide, stramineous, unmarked. Somatic chromosomes 22. Plants otherwise similar to *T. Lindheimeri*. Flowering collections from April to August.

Distribution. Hays(?) and Uvalde Counties, Texas, United States, to Coahuila, Nuevo León and San Luis Potosí, Mexico. Maps 14 and 18.

Specimens examined. UNITED STATES. Texas. Hays Co.?:

San Marcos and vicinity (county not noted), *S. W. Stanfield* (NY). Uvalde Co.: gravelly open ground, *E. J. Palmer 12296*, 18 June 1917 (GH, MO, NY, US); rocky banks along Leana River, near Uvalde, *E. J. Palmer 33665*, 30 Apr. 1928 (GH, MO, NY, PH, US); dry rocky ground, Sabinal, *E. J. Palmer 10246*, 19 June 1916 (DS, MO, US).

MEXICO. Coahuila: Hacienda La Rosita, Muzquiz, *Wynd & Mueller 298*, 26 June 1936 (A, MO, NY, US); Muzquiz, *E. Marsh 50*, 1935 (F, GH, TEX), *1152*, Apr. 1938 (GH). Nuevo León: Sierra Madre near Monterrey, *Pringle 2796*, 29 May 1889 (GH, MEXU, US); Diente Canyon (ca. 12 mi. south of Monterrey), Sierra Madre, Monterrey, *C. & M. Mueller 512*, 11 July 1933 (F, TEX), *512*, 23 July 1933 (A); Horsetail Falls, 38 km. (23 mi.) south of Monterrey on Pan-American Highway, *C. & E. Frye 2463*, 25 Apr. 1939 (GH, UC, US); limestone soil (?), weedy hillside pasture between Cieneguilla and Hacienda Vista Hermosa on road from Pan-American Highway to Horsetail Falls (Cola de Caballo), ca. 38 km. south of Monterrey, *Moore & Wood 3618*, 28 June 1948 (GH, UC, Bailey Hortorium). San Luis Potosí: Rascón, *Purpus 5273*, Aug. 1911 (GH, MEXU, MO, NY, UC).

Tephrosia potosina and *T. Lindheimeri* constitute a pair of closely related but distinct species without obvious close relationships with any other American members of the genus. The combination of characters by which they stand apart includes the sympodial decumbent habit, obovate to orbicular leaflets, rose-purple flowers, cohering vexillary stamen, broad pods, and few (4–8), large, stramineous, unmarked seeds. The two occupy contiguous ranges and appear to be the only species of the barbi-styled group which occur at least partially on soils derived from calcareous rocks. These two species are, however, distinct from each other in a number of particulars set forth in the accompanying table. The most conspicuous of these differences are those related to stature and to number and pubescence of the leaflets.

Although entire plants of *Tephrosia Lindheimeri* are seldom collected, when this species is seen in the field the much longer stems and more robust habit are conspicuous in comparison with the relatively slender and short stems of *T. potosina* (which in all of the herbarium-specimens seen have been collected with a part of the slender, woody crown). In the single colony of each which I have studied this habital distinction was very striking. Although from the available herbarium-specimens ecological conditions might be suspected of being responsible for the relatively small size of plants of *T. potosina*, all indications were to the

	T. Lindheimeri	*T. potosina*
Stature	Coarse, stems to 1 m. long, 5 mm. thick.	Slender, stems to 0.5 m. long, 2.5 mm. thick.
Leaves	5–15(–20) cm. long.	7–22 cm. long.
Petioles	(1.6–)2.5–4.5 cm. long, pubescence ascending or spreading, cinereous.	(1.5–)2.5–10 cm. long, pubescence often spreading-retrorse, often rusty.
Leaflets	(5–)7–15(–19), predominantly 9–11.	3–9, predominantly 5–7.
	11–37 mm. long, (7–)12–21 (–27) mm. wide.	10–50 mm. long, 7–40(–45) mm. wide.
Indument of upper surfaces of leaflets	Densely strigillose or hirtellous to hirsutulous or short-strigose with cinereous hairs, to nearly glabrous with only a few appressed hairs around the margins; margins conspicuously bordered with white hairs.	Completely glabrous; margins inconspicuously bordered with tawny or rusty hairs.
Flowers	Banner with a white spot at the base of the blade.	Banner with a green spot at the base of the blade.
	Calyx and back of banner with white or cinereous hairs.	Calyx and back of banner with golden or rusty hairs.
Ovules and seeds	5–6	4–8

contrary, with plants of this species less than one-half the size of fruiting plants of *T. Lindheimeri* (as seen in Texas) fruiting abundantly in a habitat seemingly far better suited than Texas to profuse growth.

The 3–9 (predominantly 5–7) leaflets of *Tephrosia potosina* are a very constant character. On some 90 plants examined in a colony near Monterrey (*Moore & Wood 3618*) no leaves bore more than 9 leaflets. In *T. Lindheimeri*, however, the leaflet-number varies from 5 to 19, with 9–11 occurring most commonly.

Although the indument of the leaflets has proved to be untrustworthy in a number of species of *Tephrosia*, in this instance leaflet-pubescence shows perfect correlation in all of the available material with the leaflet-numbers given above. Within a single colony of *Tephrosia Lindheimeri*, plants with the upper surfaces of the leaflets evenly hirsutulous, or with the center of the leaflets glabrous, or grading from this to the restriction of the whitish hairs to a narrow submarginal zone are encountered. Although

several collections show some very nearly glabrous leaflets, there are always a few appressed whitish hairs near the margins of the leaflets, in addition to the conspicuous edging of antrorsely directed whitish hairs on the margins themselves. The leaflets of *Tephrosia potosina*, however, are always completely glabrous above and the marginal border of tawny to rusty hairs is inconspicuous. In addition to the herbarium-material, mass collections from 129 plants of *T. Lindheimeri* (*Moore & Wood 3617*) and 90 of *T. potosina* (*Moore & Wood 3618*) showed no exceptions.

Further examination of fresh flowering material is desirable before much significance can be assigned to the color of the spot at the base of the banner. The color of hairs on calyx and back of the banner does, however, seem to be of diagnostic importance in these two species.

24. **Tephrosia saxicola** sp. nov.

Planta perennis herbacea decumbens. Caules graciles basi sublignosi, 1–5 dm. longi, sparso-strigillosi. Folia 3–9 cm. longa; petioli (2–)5–17 mm. longi; stipulae lineari-acuminatae, persistentes; foliola 9–19, angustato-elliptica, oblonga vel lineari-oblonga, mucronata, (8–)10–23 mm. longa, 3–6(–8) mm. lata, coriacea, supra nitida, glabra vel nervus primarius strigillosus, subtus substrigillosa pilis albidis, pallida vel canescentia. Inflorescentiae terminales vel axillares, 3–20 mm. longae, laxae, ascendentes plerumque efoliatae; nodi floriferi 5–20. Bracteae primariae lineari-lanceolatae vel subulatae, 4–8 mm. longae, brunneae, persistentes. Pedicelli 4–9 mm. longi. Calyx campanulatus, 4–5.5 mm. longus, strigillosus pilis aureis et cinereis; lobi deltoidei vel deltoideo-ovati, abrupte acuminati, lobi superiores 1–1.5 mm. longi, lobi laterales 2.5–3 mm. longi, lobus infimus 3 mm. longus. Vexillum roseo-purpureum, basi macula viridia; lamina 11–13 mm. longa, 13–14 mm. lata; alae 13–15 mm. longae; carina 13–14 mm. longa, ungue 3 mm. longo. Tubus staminalis 10–11 mm. longus; stamen vexillare tubo connatum, basi liberum. Ovarium strigillosum, 6–9-ovulatum; stylus barbatus. Legumen immaturum 3 cm. longum, 5 mm. latum, raro-strigillosum pilis cinereis.

Decumbent perennial herb, somewhat woody at the base; stems slender, 1–5 dm. long, clustered, much branched, monopodial, terete below, somewhat angled above, striate. Stems, petioles, rachises and axes of inflorescences thinly strigillose with whitish hairs. Leaves 3–9 cm. long, spreading or ascending, the petioles (2–)5–17 mm. long, mostly shorter than the lowermost leaflets, the rachis (0.5–)2.5–5.5 cm. long, both petiole and rachis channeled on the upper side; stipules linear, acuminate, 10 mm. or less long, brown, persistent; leaflets of the principal leaves 9–19, narrowly elliptic to oblong or linear-oblong, (8–)10–23 mm. long, 3–6(–8) mm. wide, the base and apex acute to rounded; leaflets coriaceous, lustrous, glabrous or with a few short white hairs along the midrib and nearly lacking stomata above, moderately white-strigillose beneath, appearing pale or canescent; petiolules 0.5–1.5 mm. long, strigillose. Inflorescences terminal and axillary, 3–20 cm. long, ascending, slender, often lax, sometimes with 1–3

short branches from the axils of bracts, leafless or the lowermost node with a leaf, the peduncle 1–4 cm. long, the axis angular, the flowering nodes 5–20, rather evenly spaced; buds 3–4 at a node, 2–3 of these flowering. Primary bracts linear-lanceolate to subulate, 4–8 mm. long, brown and persistent, conspicuous; secondary bracts subulate, 2–4 mm. long, brown, persistent. Pedicels 4–9 mm. long, ascending, strigillose with golden or rusty hairs. Dried flowers 13–15 mm. long. Calyx campanulate, 4–5.5 mm. long, strigillose with fine golden or rusty and cinereous hairs, the tube 2.5–3 mm. long, the lobes triangular to triangular-ovate, rather abruptly acuminate, the upper 1–1.5 mm. long, the lateral 2.5–3 mm. long, the lowermost 3 mm. long. Corolla "bright pink-lavender", the banner with a conspicuous green area near the base; blade of the banner 11–13 mm. high, 13–14 mm. broad, strigillose on the back with fine silky golden hairs, the claw 3–4 mm. long; wings 13–15 mm. long, 4–5 mm. broad, auricled, the claw 2.5–3 mm. long; keel 13–14 mm. long, 6–7 mm. deep, the claw 3 mm. long. Staminal tube 10–11 mm. long, the vexillary stamen coherent with the tube, free at the base, with a prominent callosity on the upper side near the base. Ovary strigillose, the style barbate; ovules 6–8. Mature fruit not seen, the immature legume ca. 3 cm. long, 5 mm. wide, slightly curved upward, thinly strigillose with cinereous hairs. Fig. 1, Plate 1153.

Distribution. Known only from the type-locality. Map 19.

Specimens examined. MEXICO. Sinaloa: Caespitose, suffrutescent, spreading herb with bright pink-lavender flowers, open rocky slope with lower pines and oaks, 4500 ft. (1400 m.), Puerto a Tamiapa, Dto. de Badiraguato, *H. S. Gentry 5812*, 5 March 1940 (GH-Type; DS, MEXU, MO, NY, UC) (see Gentry 1946 for map and exact location).

Tephrosia saxicola is clearly distinguished by the 9–19 small, coriaceous leaflets, by the slender, often elongate inflorescences with persistent bracts, and by the deltoid to deltoid-ovate lobes of the calyx. The short, thin and tightly appressed pubescence also appears to be characteristic. This species is probably most closely related to *T. Seemannii*, but that poorly known species has very short inflorescences, narrowly triangular, subulate calyx-lobes and very much longer pubescence.

25. **Tephrosia Seemannii** (Britten & Bak. f.) K. Schum.

Cracca Seemanni Britten & Bak. f. Jour. Bot. **38:** 16. 1900. "In woods, Sierra Madre", (between Mazatlán and Durango or Durango and Tepic, in Sinaloa, Durango or Nayarit), Mexico, *Seemann 2191*, Nov. 1849–Feb. 1850 (K, GH).

Tephrosia Seemannii (Britten & Bak. f.) K. Schum. in Just, Bot. Jahresb. **28**(1): 442. 1902.

Herbaceous or suffruticose perennial from a slender crown; stems ap-

parently decumbent or erect, 1.5–4 dm. long, terete or somewhat angled above, striate, 1–2 mm. thick, slightly flexuous, often with short axillary branches 1.5–7 cm. long. Stems, petioles, rachises, petiolules, inflorescences, pedicels and calyces sparsely to densely strigillose with fine white or gray hairs and sparsely to densely covered with coarser spreading hairs up to 2 mm. long. Principal leaves spreading, 2.2–5.5 cm. long, the petioles (1.5–)2–6 mm. long, shorter than the lowermost leaflets, the rachis 1.5–4 cm. long; stipules linear, long-acuminate to linear-subulate, 4–8 mm. long, brown and persistent; leaflets of the principal leaves 9–21, narrowly oblong-elliptic to lanceolate-oblong or oblong, the base usually obtuse or rounded, rarely narrowed, the apex acute, obtuse or rounded, rarely retuse, mucronate, tapering evenly or slightly broader below the middle, 7–15 mm. long, 2.5–5.5 mm. wide, those near the center of the leaf longest, the lowermost shortest; leaflets coriaceous, the margins usually slightly involute, the midvein conspicuously impressed, the parallel lateral veins obscure, the veinlets between somewhat impressed, forming a network, the areoles not elongate but more or less isodiametric; upper epidermis lacking stomata; upper surface of leaflets with very fine appressed to ascending hairs 0.2–0.6 mm. long, becoming more or less glabrous except along the midrib; lower surface of leaflets densely strigose with white or cinereous hairs, the midrib conspicuous, brown or reddish, with scattered spreading hairs about 1 mm. long, appearing somewhat silky but not shining or silvery; petiolules inconspicuous, ca. 0.6 mm. long. Inflorescences terminating the main branches or short leafy axillary branches, 1–4 cm. long, the peduncle up to 1.2 cm. long, the inflorescences few-flowered with 2–7 flowering nodes; buds ca. 3 at a node, 2 or 3 flowering. Primary bracts linear to linear-lanceolate, acute or acuminate, often 3-toothed, brown, persistent, 4–7 mm. long; secondary bracts linear-subulate, 3–5 mm. long, brown, apparently persistent. Pedicels slender, ascending, 4–11 mm. long. Dried flowers ca. 13–15 mm. long. Calyx ca. 6 mm. long, the upper lobes subulate, ca. 2 mm. long, the lateral and lowermost narrowly triangular-subulate, ca. 4 mm. long. Corolla "purple" (Seemann), apparently with a green spot at the base of the banner within, brown when dry; blade of the banner ca. 11 mm. high, finely white-hairy on the back, the claw ca. 2 mm. long; wings ca. 14 mm. long, ca. 4 mm. wide, the claw 2.5 mm. long; keel ca. 14 mm. long, exauriculate, the claw ca. 3.5 mm. long. Staminal tube 10–11 mm. long, the vexillary stamen coherent with the staminal tube, free at the base, thickened on the upper side near the base. Ovary strigillose or ascending-hirtellous with white hairs, the style barbate on the inner surface; ovules ca. 8. Very young legumes hirtellous with fine white or (along the sutures) rusty hairs; mature legumes and seeds unknown.

Distribution. Mountains of southern Sinaloa and probably Nayarit, Mexico. Map 19.

Specimens examined. MEXICO. Sinaloa, Durango or Nayarit: In woods, Sierra Madre, (between the cities of Mazatlán and Durango or

Durango and Tepic), *Seemann 2191*, Nov. 1849–Feb. 1850 (GH, K). Sinaloa: Sierra de Chabarria, *J. G. Ortega 4049*, 1921 (US).

This little-known species was thought by Seemann to be related to *Tephrosia virginiana*, a supposition in which he was followed by Britten and Baker and by Rydberg. It appears, however, that the real affinities of *T. Seemannii* are with *T. Pringlei* of central Oaxaca and *T. saxicola* of central Sinaloa; the resemblance to *T. virginiana* is superficial only. *Tephrosia Seemannii* strongly resembles *T. Pringlei* in the number, size and shape of the leaflets, which are finely hairy above and densely white-hairy beneath, but rather more coriaceous in the former species. The persistent bracts are also similar and floral measurements overlap. The two are clearly different, however, in the venation of the leaflets, in the distribution of stomata and in several other tendencies as indicated below. Until more material is available little dependence can be placed upon floral characters.

	T. Seemannii	*T. Pringlei*
Stems	1.5–4 dm. long.	1.2–5 dm. long.
Stipules	Linear, long-acuminate, to linear-subulate.	Linear, acute or acuminate.
Leaflets	9–21, narrowly oblong-elliptic to lanceolate-oblong or oblong, tapering evenly or slightly wider below the middle.	9–25, obovate, obovate-cuneate, narrowly cuneate or elliptic, usually broadest above the middle.
	Parallel lateral veins inconspicuous, the areoles between the lateral veins nearly isodiametric.	Parallel lateral veins conspicuous, the areoles between the lateral veins distinctly elongate.
	Upper epidermis without stomata.	Upper epidermis with stomata.
Nodes of the inflorescence	2–7	3–12

26. **Tephrosia Pringlei** (Rose) Macbr.

Cracca Pringlei Rose, Bot. Gaz. **40:** 143. 1905. Gravelly slopes under oaks, hills of Las Sedas, Dist. Etla, Oaxaca, Mexico, *C. G. Pringle 6741*, 22 July 1897 (US 42396-Type; CAS, GH, MEXU, NY, PH, UC, US).

Tephrosia Pringlei (Rose) Macbr. Field Mus. Publ. Bot. **4:** 87. 1925.

Much-branched herbaceous perennial from a slender branching woody crown and heavy woody root; stems many, 1–2.5 dm. long, apparently erect or somewhat decumbent, terete or somewhat angled, striate. Stems,

petioles, rachises, petiolules and axes of inflorescences moderately hirtellous to hirsutulous or strigillose to strigose with fine cinereous or brownish hairs. Principal leaves 2.5–6.5 cm. long, the petioles 2–8(–9) mm. long, the rachis 1.8–5 cm. long, stipules linear, acute or acuminate, 5–10 mm. long, 1–1.5 mm. or less wide, persistent, brown; leaflets of the principal leaves 9–25, obovate, obovate-cuneate, narrowly cuneate or elliptic, usually broadest above the middle, usually narrowed toward the base, the apex obtuse, rounded or retuse, mucronate, 5–15 mm. long, 2–5.5(–7) mm. wide, those of a leaf rather uniform in size, light green, firm, veiny on the upper side, the parallel lateral veins evident, the smaller veinlets forming elongate areoles between, the upper epidermis with stomata; upper surfaces of the leaflets nearly glabrous to sparsely to densely covered with fine cinereous hairs, at least the midrib with a few hairs, appearing silvery and silky or somewhat woolly below, the lower surfaces densely strigillose and strigose to hirsutulous with cinereous hairs. Inflorescences terminal (or occasionally 1–3 additional short inflorescences axillary), usually compact, 1.5–12 cm. long, few-flowered, leafless or one node with a leaf, the peduncle up to 5 cm. long, the flowering nodes 3–12; buds 3–5 at a node, 2 or 3 flowering, 1 or 2 fruiting. Primary bracts linear to linear-lanceolate, acuminate, 3–7 mm. long, persistent, brown; secondary bracts 2–4 mm. long, linear, persistent. Pedicels slender, 6–12 mm. long in flower, 10–16 mm. long in fruit, ascending. Dried flowers 14–20 mm. long. Calyx and pedicels usually doubly pubescent, hirtellous to strigillose and hirsutulous to short-strigose with cinereous or brownish hairs. Calyx 6–10 mm. long, the tube 2–3 mm. long, the upper lobes long-acuminate (2.5–)3.5–6 mm. long, the lateral and lowermost lanceolate, long-acuminate, 4–7 mm. long, usually nearly equal in length. Corolla in dried specimens purple to brown, the banner with a conspicuous yellowish-green spot near the base; blade of the banner suborbicular, 11–15 mm. high, 12–15 mm. wide, covered on the back with fine golden and white hairs, the claw 2–3 mm. long; wings 13–16 mm. long, 4–6 mm. wide, the claw 2–3 mm. long, not conspicuously auricled, but rounded at the base on the upper side and folded, thus appearing auriculate; keel semilunate, ca. 15 mm. long, exauriculate, the claw 2.5–3 mm. long. Staminal tube 10–12 mm. long, the vexillary stamen coherent with the tube, free at the base, thickened but not conspicuously so on the upper side near the base. Ovary densely strigillose or hirtellous with white or (along the margins) rusty hairs. Partially mature pod 4 mm. long, 6–6.5 mm. wide, the upper side slightly curved downward, tipped by the persistent style-base which curves downward, compressed, hirtellous with brown and white hairs; seeds 6–8, the mature seeds unknown. Flowering collections late June and July.

Distribution. Oak woods, 2000–2300 m., central Oaxaca, Mexico. Map 19.

Specimens examined. MEXICO. Oaxaca: San Fo. Huiso, 7000 ft., *Galeotti 3458*, June 1849 (US, NY); gravelly slopes under oaks, hills of Las Sedas, Dist. Etla, *Pringle 6741*, 22 July 1897 (CAS, GH, MEXU, NY,

PH, UC, US); La Carbonera, 2200 m., Dist. Etla, *Conzatti 4019*, 28 June 1920 (MEXU); Rancho Nopalera, Camino Montelobos, Dist. Nochixtlán, 2000 m., *Conzatti 1868*, 22 June 1907 (NY, US); Cerro de Nueve Puntas, Matatlán, Dist. Tlacolula, 2500 m., *Conzatti & Vazquez 1495*, 19–23 June 1906 (MEXU, NY, US); Cuatro Venados, Dist. Zimatlán, 7500 ft., *L. C. Smith 61*, 27 June 1894 (GH, US).

27. **Tephrosia nicaraguensis** Oerst. ex Benth. & Oerst.

Tephrosia nicaraguensis Oerst. ex Benth. & Oerst. Kjoeb. Vidensk. Meddel. **1853:** 6. 1854. Savannas between Granada and Masaya, Nicaragua, presumably *Oersted 4622*, Dec. 1847 (F, US).

Cracca nicaraguensis (Oerst. ex Benth. & Oerst.) Kuntze, Rev. Gen. **1:** 175. 1891.

Tephrosia talpa S. Wats. Proc. Amer. Acad. **22:** 405. 1887. "Río Blanco, on hillsides under pines, growing in clumps," (about 10 mi. west by north of Guadalajara), Jalisco, Mexico, *Edward Palmer 161*, July 1886 (GH-Type; MEXU, NY, US).

Cracca talpa (S. Wats.) Rose, Bot. Gaz. **40:** 143. 1905.

Erect perennial or suffrutescent herb 2–5(–10?) dm. high; stems many from a heavy woody crown and thick woody root, monopodial. Stems, petioles, rachises, petiolules and axes of the inflorescences densely hirtellous or hirsutulous (or both) with cinereous or tawny hairs, appearing velvety or woolly. Leaves ascending or spreading, (8–)12–24 cm. long, the leaflets often drooping, the petioles (11–)23–57 mm. long, longer or shorter than the lowermost leaflets, the rachises (5–)7–16 cm. long; stipules linear, acuminate, 6–17 mm. long, 1 or rarely 1.5 mm. or less wide, persistent, becoming brown; leaflets of the principal leaves 9–21, narrowly oblong to oblong to elliptic, (11–)16–50(–60) mm. long, (7–)8–17(–19) mm. wide, (1.5–)2–4 times as long as broad, the lowermost leaflets shortest, the apex of leaflets obtuse, rounded or retuse, short-mucronate, the base obtuse (often narrower than the apex, rarely acute); leaflets thickish, dull, densely soft-hirtellous with fine cinereous hairs, often appearing velutinous or canescent above, conspicuously reticulate between the lateral veins below with the areoles nearly isodiametric, hirsutulous, especially along the midrib and parallel lateral veins which are conspicuously outlined with whitish or tawny hairs, often appearing somewhat woolly or silky; petiolules ca. 2.5 mm. long. Inflorescences usually terminal, stout, straight, 5–35 cm. long, or accompanied by 1–5 slender inflorescences 2–15 cm. long from the upper axils, the uppermost leaf often with axillary flowers, the peduncles of the inflorescences 2–10 cm. long, angular, the inflorescences bearing 5–ca. 25 flowering nodes which are buttressed below; buds 5–12 at a node, 4 or more flowering, 1–3 fruiting. Primary bracts linear, acuminate, 6–14 mm. long, 1 (or rarely 1.5) mm. or less wide, persistent; secondary bracts linear-subulate, 3–5 mm. long, usually persistent. Pedicels 2–5(–6) mm. long, ascending. Dried flowers 14–18 mm. long. Pedicels and calyces densely hirtellous and hirsutulous with rusty to cinereous hairs. Calyx (4–)5–7 mm. long, the upper lobes acuminate, 1–2

mm. long, the lateral deltoid or narrowly so, short-acuminate, (1.5–)2.5–3 mm. long, the lowermost lanceolate, acuminate, (1.5–)4–5 mm. long. Banner white becoming pink with age, the wings and keel apparently rose-pink or the keel paler, the corolla usually brown when dry; blade of the banner suborbicular to obovate, 14–17 mm. high, 13–18 mm. wide, densely covered with fine silky hairs on the back, the claw 2.5–4 mm. long; wings 15–18 mm. long, 3–5.5 mm. wide, auricled, the claw ca. 3 mm. long; keel 15–17 mm. long, with or without an auricle, the claw 3 mm. long. Staminal tube 11–13 mm. long, the vexillary stamen coherent with the tube, free at the base, with a conspicuous 2-lobed thickening on the upper side near the base. Ovary densely silky- to woolly-hirsutulous. Legume nearly straight or slightly curved downward and often narrowed near the base, 3–6 cm. long, 5–6.5 mm. wide, densely hirsutulous with cinereous to rusty hairs (about 1–1.5 mm. long), the hairs often matted, woolly or furry in appearance; seeds 4–8, brown variegated with black, nearly orbicular or subquadrate in outline, 3.6–3.8 mm. in diameter, laterally compressed.

Distribution. Well-drained rocky soils in open oak and pine woods, 400–1750 m., from southern Sonora and southwestern Chihuahua to Chiapas and Oaxaca, in Mexico, and to Guatemala, Honduras, El Salvador and Nicaragua. Map 3.

Specimens examined. MEXICO. Chihuahua: Sunny oak slope, Sierra Canelo, Río Mayo, *Gentry 2527* (A, F, MO); oak savanna, Batopilillas, Río Mayo, *Gentry 2613* (A, F, MO) (see Gentry 1942 for map). Sonora: Valley of the San Ignacio River, *Capt. E. K. Smith* (NY); Sierra Verde, *Schott*, 1855 (NY, US). Sinaloa: In open places, Mesa de Lagunillas, Ixtagua, San Ignacio, 440 m., *Montes & Salazar 449* (US); Ixtagua, San Ignacio, *Ortega 484* (MEXU); Cerro Colorado [ca. 30 mi. east of Culiacán], *Brandegee*, 1904 (UC); open rocky slopes on oak savanna, Mesa Malqueson, Cerro Colorado, 2500 ft., *Gentry 5176* (DS, GH, MO, NY, UC); Cofradia [east of Culiacán], *Brandegee*, 21 Oct. 1904 (UC, US). Durango: *Rose 2261* (US); Ramos to Inde, *Nelson 4711* (NY, US); Durango & vicinity, *Palmer 632*, 1896 (GH, MO, NY, UC, US); rocky slope 35 km. south of Durango, *Hernandez X. X2584* (GH). Guanajuato: Oak zone, Dolores Hidalgo to Guanajuato, *Kenoyer 2116* (GH). Querétaro: Hacienda [del] Ciervo, between San Juan del Río and Cadereyta, *Rose, Painter & Rose 9694* (GH, MEXU, NY, US). Jalisco: Guadalajara, *Holway 5151* (US); near Guadalajara, *Rose & Painter 7471* (GH, NY, US); rocky hills near Guadalajara, *Pringle 5137* (GH, MEXU), *9774* (GH, MO, NY, US), *4396* (MO, NY, PH, UC, US); barranca of Río Blanco near Guadalajara, 4500 ft., *Pringle 11437* (GH, MEXU, US); on hillsides under pines, Río Blanco, *Palmer 161*, 1886 (GH, MEXU, NY, PH, US); near Tequila, *Rose & Hough 4753* (US); open grassy hillside with rocky volcanic outcrops near top of hill ca. 4–5 km. beyond Tequila on road to Tepic, 4500 ft., *Moore & Wood 4830* (GH, UC, Bailey Hortorium); rocky mountain slopes with open oak woods near Arenal on highway from Guadalajara to Tequila, 5300 ft., *Moore & Wood 4834*

(GH, UC, Bailey Hortorium). México: Prairie, Volcán, Dist. Temascaltepec, 1410 m., *Hinton 1278* (GH, MEXU, NY, US). Morelos: Woods near El Rodeo, *Clausen 6059* (DS, MEXU). Guerrero: Clay soil, Valle Grande, Mont de San Cristobal (apparently in Dist. Montes de Oca), *Langlassé 324* (GH, US). Oaxaca: *Holway 3679* (GH); Oaxaca, 1750 m., *Conzatti & Gonzalez 39* (MO, US); Natividad Road, n.e. of Oaxaca, *Kenoyer 1567* (GH); valley of Oaxaca, 5500–7500 ft., *Nelson 1456* (US); San Felipe and Monte Albano, *Rose & Hough 4577* (US, NY-photo); San Benito, near Apango, 500 m., *Reko 3619* (US); Talea (Chinantla), *Galeotti 3466* (GH, NY, UC, US); Faldas del Fortín, 1600 m., Dist. del Centro, *Conzatti 3578* (MEXU); Ferrenos de Xochimilco, 1560 m., Dist. del Centro, *Conzatti 3645* (MEXU). Veracruz: Region of Orizaba, Borrego, *Bourgeau 2797* (part) (US). Chiapas: Chicomuselo, 800 m., *Matuda 4425* (A, MO, NY); Hacienda Monserrate, *Purpus 9143* (F, MO, US); rocky mountain slope east of Hacienda Monserrate, *Purpus 10092* (NY, UC, US), *Clausen & Cervantes 6101* (DS, MEXU).

GUATEMALA. Chiquimula: Grassy slope of Mount Tejás, near village of Sasmo, ca. 1 mi. n.w. of Chiquimula, 420–520 m., *Steyermark 30206* (F); dry, open, rocky slopes in openings of pine woods, Caracol Mountain, 1.5 mi. north of Quetzaltepeque, 1200–1400 m., *Steyermark 31375* (F). Huehuetenango: Along Río Cuilco between Cuilco and aldea of San Juan, 2.5 mi. west of Cuilco, 1200–1300 m., *Steyermark 50867* (F). Jutiapa: Oak and pine forest at La Pava below Acatempa, 1100 m., *Standley 77597* (F); open rocky pine forest, hills between Jutiapa and Plan de Urrutia, north of Jutiapa, 900–1200 m., *Standley 75602* (F); pine forest, low mountains west of Jutiapa, 900 m., *Standley 60565* (F). Zacapa: Rocky, dry hills between Monte Grande and Santa Rosalía, 300–1200 m., *Steyermark 42191* (F).

HONDURAS. El Paraiso: Dry rocky hillsides ca. 5 km. east of Ojo de Agua, 760 m., *Williams & Molina 10485* (UC).

EL SALVADOR. Santa Ana: Fondo del Cerro de la Olla, near Chalcuapa, *Calderón 1009* (NY, US).

NICARAGUA. Between Granada and Masaya, *Oersted 4622* (F, US).

Although *Tephrosia nicaraguensis* and *T. talpa* have previously been recognized as separate species, the differences have been mainly political, specimens from Guatemala southward being referred to the former and those from Mexico to the latter name. The type-collections correspond in all particulars, however, and clearly represent the same species. Rydberg apparently did not see authentic material of *T. nicaraguensis*, so that the differences given by him (1923) seem to have come solely from the original incomplete descriptions of the two species. In spite of the broad range of this plant no geographical variations are evident.

28. **Tephrosia submontana** (Rose) Riley

Cracca submontana Rose, Contr. U. S. Nat. Herb. **8:** 46. 1903. Between Pedro Paulo and San Blascito, Nayarit, Mexico, *J. N. Rose 3336*, 4 Aug. 1897 (US 302312-Type; GH, MEXU; NY-photograph).

Tephrosia submontana (Rose) Riley, Kew Bull. **1923:** 341. 1923.

Erect herbaceous to shrubby perennial ca. 1 m. high. Stems, petioles, rachises, petiolules, and axes of the inflorescences densely strigillose or hirtellous with rusty-brown hairs, velutinous or silky. Leaves 9–22 cm. long, the petioles 6–25 mm. long, shorter than the lowermost leaflets, the rachis 5–14 cm. long; stipules linear, acute or acuminate, 5–15 mm. long, ca. 1 mm. wide, persistent but often broken in herbarium-specimens; leaflets (11–)13–17, lanceolate, lance-oblong, or linear-oblong, the base rounded or obtuse, the apex acute, cuspidate, 2–6 cm. long, (5.5–)8–15 mm. wide, somewhat coriaceous, green, shining, minutely pubescent with hairs 0.1–0.2 mm. long above, the veins conspicuous, densely strigillose to strigose beneath with fine golden or silvery shining hairs, silky in appearance; petiolules 1.5–4 mm. long, slender. Inflorescences several, terminal and axillary, 7–35 cm. long, the peduncle 3–8 cm. long, the terminal inflorescence with 1 or 2 branches, leafless, erect, usually lax, many-flowered, the flowering nodes 5–40; buds 5–8 at a node, 3–6 of these flowering, 1 or 2 fruiting. Primary bracts lanceolate or linear-lanceolate, 10 mm. or less long, deciduous; secondary bracts linear-lanceolate or linear, 2–4 mm. long, deciduous. Pedicels ascending, 5–8 mm. long, rusty-strigillose or hirtellous. Dried flowers 20–30 mm. long. Calyx 6–7.5 mm. long, strigillose or hirtellous with rusty hairs, the tube ca. 4 mm. long, the lobes triangular to ovate and short-acuminate, the upper 1–1.5 mm. long, the lateral 3.5–4 mm. long, the lowermost 4 mm. long. Corolla of dried specimens purple to brown; blade of the banner suborbicular, 22–25 mm. high, 20–22 mm. broad, densely golden-strigillose on the back, the claw ca. 3 mm. long; wings ca. 28 mm. long, 6 mm. wide, auricled, the claw 4 mm. long; keel ca. 25–27 mm. long 7–10 mm. deep, auricled, the claw 4 mm. long. Staminal tube 19–21 mm. long, the vexillary stamen free at the base, with a conspicuous callosity on the upper side near the base. Ovary densely strigillose to short-strigose. Legumes nearly straight, somewhat narrowed and curved near the base, spreading, 7–10 cm. long, 5–7 mm. wide, densely hirsutulous with rusty-brown hairs, usually appearing finely velutinous; seeds 13–17, the mature seeds not seen.

Distribution. Presumably in oak woodland, apparently primarily at relatively low altitudes (600–700 m.), Sinaloa and Nayarit, Mexico. Map 18.

Specimens examined. MEXICO. Sinaloa: "Western Mexico", *Seemann* (GH) (probably *Tephrosia leucantha* of Seem. Bot. Voy. Herald. 280. 1856, not HBK., from Cerro de Pinal, Sinaloa, according to Riley, Kew Bull **1923:** 341. 1923); Picachos, Municipalidad Rosario, *Ortega 7139* (CAS, F, MEXU, US); Cordón de las Trompetas, Ixtagua, San Ignacio, 660 m., *Montes & Salazar 489*, 17 Aug. 1918 (US); Falda del C[erro] del

Perico, San Ignacio, 620 m., *Montes & Salazar 539*, 2 Sept. 1918 (US); Cerro del Perico, 620 m., El Limón, San Ignacio, *Ortega 394* (MEXU). NAYARIT: Between Pedro Paulo and San Blascito, *Rose 3336*, 4 Aug. 1897 (GH, MEXU, US; NY-photo); between Aguacata and Dolores, *Rose*, 6 Aug. 1897 (US).

29. **Tephrosia nitens** Benth. ex Seem.

Tephrosia nitens Benth. ex Seem. Bot. Voy. Herald 107. 1853. Island of Taboga, Bay of Panama, Panama, *Seemann* (F-, NY-photograph of *Seemann 1036* at K).

Cracca nitens (Benth. ex Seem.) Kuntze, Rev. Gen. **1:** 175. 1891.

Tephrosia nitens var. *lanata* Micheli in Dur. & Pitt. Bull. Bot. Soc. Belg. **30**(1)**:** 286. 1891. Cotypes collected in Costa Rica, "Terraba," *Pittier 3809*, Feb. 1891 and "savanes de Buenos Aires," *Pittier 3822* (F-fragment of *3809* ex Herb. Berol.; F-, GH-photograph of *3809* in Herb. Berol.; US-2 sheets of *Tonduz 3809*, "savanes des monts de Terraba," Feb. 1891, which may represent the same collection).

Tephrosia albida Brandeg. Univ. Calif. Publ. Bot. **10:** 406. 1924. Rocks along the road from Tuxtla Gutierrez to Jalisco, Chiapas, Mexico, *C. A. Purpus 9136*, Sept. 1923 (UC 220439-Type).

Erect herb from a woody crown, or a sparsely-branched shrub 3 m. high. Stems, petioles, rachises, petiolules and pedicels densely short-strigose to strigose or spreading-hirsute or villous with fine soft cinereous to tawny hairs up to 3 mm. long, appearing somewhat lanate. Leaves 2–15 cm. long, the petiole 2–5 mm. long, the rachis 1–6.5 cm. long, sometimes 2.5 mm. broad, deeply channeled on the upper side; stipules lanceolate to broadly ovate, acuminate, 6–12 mm. long, 2–6 mm. wide, sometimes persistent; leaflets of the principal leaves (1–)5–13, oblong-cuneate to oblanceolate or linear-oblong, rarely somewhat elliptic, the apex rounded, retuse or obtuse, mucronate, the base narrowed, (14–)18–80 mm. long, (5–)7.5–18(–23) mm. wide, 3–7 times as long as broad, the lowermost smallest, the terminal largest; leaflets coriaceous, yellowish-green, glabrous above, silky, densely strigose beneath with shining cinereous to golden hairs or with scattered long spreading hairs along the midrib and veins; veinlets between the main lateral veins running more or less parallel, forming elongate areoles between; petiolules 2–3 mm. long. Inflorescences terminal and axillary, ascending or erect, usually exceeding the leaves, the principal inflorescence terminal, 5–50 cm. long, the peduncle 3–7 cm. long, the uppermost 1–5 leaves sometimes with axillary flowers; axillary inflorescences slender, 5–25 cm. long; flowering nodes 5–ca. 50; buds 5–7 at a node, 4–5 flowering, 1–2 fruiting. Primary bracts lanceolate to ovate, acuminate, 5–13 mm. long, 2–4 mm. wide, deciduous; secondary bracts lanceolate to ovate-lanceolate, acuminate, 4–8 mm. long, deciduous. Pedicels 6–8 mm. long, ascending, ca. 1 mm. in diameter in fruit. Dried flowers 15–20 mm. long. Calyx 6–8 mm. long, densely hairy with appressed to spreading white hairs up to 3 mm. long, the upper lobes deltoid-subulate, 2–5 mm. long, the lateral deltoid-acuminate or lance-subulate,

4–5 mm. long, the lowermost lanceolate-acuminate, 4–7 mm. long. Corolla rose or white, the banner with a greenish spot at the base; blade of the banner orbicular to subquadrate, 12–17 mm. high, 13–17 mm. wide, densely silky-hairy on the back, the claw 2–3 mm. long; wings oblong, 15–19 mm. long, 4–5 mm. wide, with or without an auricle, the claw 2.5–3 mm. long; keel 14–18 mm. long, slightly or not at all auricled, the claw 3–4 mm. long. Staminal tube 10–15 mm. long, the vexillary stamen coherent with the tube, free at the base, with a prominent thickening on the upper side near the base. Ovary densely strigillose or hirtellous with fine hairs. Legume (3.5–)4–6 cm. long, 4.5–5.5 mm. wide, usually slightly curved downward along its entire length, the tip often contracted evenly into the persistent style-base, legumes strongly ascending, hirtellous to strigillose with very fine white or tawny hairs; seeds 9–13, broadly oval in outline, light brown variegated with black, 3–3.4 mm. long, 2.4–2.8 mm. wide. Somatic chromosomes 22.

Distribution. Rocky ground, savannas and pinelands from sea level to 800 m., from Veracruz and Guerrero, Mexico, southward to Honduras, Costa Rica and Taboga Island in the Bay of Panama; Brazil; reported from Venezuela and Colombia. Map 18.

Specimens examined. MEXICO. Guerrero: La Botella, 500 m., (Dist. Galeana or Montes de Oca), *Langlassé 670* (GH, US); Plan de Carrizo, Dist. Galeana, 800 m., *Hinton 11037* (GH); Acapulco, *Hinds*, 1842 (GH). Oaxaca: *Mell 2279* (NY); Almoloya, 100–250 m., *Williams 9839* (F); Chivela, *Mell 41* (NY, US), *Orcutt 3301* (GH, US). Veracruz: Without definite locality, *Orcutt 3301* (F). Chiapas: Sabaña Palenque, *Matuda 3758* (A, F, NY); ridge back of Tonala, 1200–2500 ft., *Nelson 2880* (NY, US); road from Tuxtla Gutierrez to Jalisco, *Purpus 9136* (UC).

BRITISH HONDURAS. Belize: Near Manatee, *Gentle 3413* (A, MO, NY, US); Baker's Pine Ridge, *Lundell 6995* (F, NY). El Cayo: Mountain Pine Ridge, *Bartlett 11608* (NY); near Jenkins Creek, north of Monkey River, Toledo Dist., *Gentle 4064* (GH); pine ridge near Manatee Lagoon, *Peck 268* (GH).

GUATEMALA. Chiquimula: Road between Jocotán and Chiquimula, 600 m., *Steyermark 31747* (F).

HONDURAS. Cortés: San Pedro Sula, *Thième*, Feb. 1887 (US).

COSTA RICA. Cartago: San Rafael, *Pittier 6991* (US). Puntarenas: Buenos Aires, Cantón de Osa, 480 m., *Valerio 861* (F); Boruca, *Tonduz 4491* (US); Río Ceiba, 250 m., *Tonduz 4991* (US); monts de Terraba, 260 m., *Tonduz 3809* (US); Terraba, *Pittier*, Feb. 1891 (F-fragment; F-, GH-photo); El General, 700 m., *Pittier 12023* (US). San José?: El General, 825 m., *Skutch 2471, 2472* (A, MO, NY, US).

PANAMA. Panamá: Taboga Island, Bay of Panama: *Seemann 1036* (F-, NY-photograph); *Standley 27999* (US); 0–250 m., *Pittier 3571* (NY, US); 300 m., *Killip 3174* (US); *Macbride 2830* (F, US); up to 300 m., *Allen 110* (GH, MO); 0–350 m., *Allen 1276* (GH, MO, US).

BRAZIL. Tropical Brazil, *Burchell 9231* (GH).

The two segregates from *Tephrosia nitens* represent normal variations of this well-marked species. The plant described as *T. nitens* var. *lanata* Micheli has 9 or 11 leaflets and blackish, lanate pubescence. The leaflet-number of the typical form of the species varies from 5 to 13, largely with the size of the plant, and the black color of the pubescence seems to be due to the progressive soiling of the long, fine hairs which often twist together late in the season.

Tephrosia albida Brandegee was said to differ in the length of the pedicels and in the "form and color of the corolla, "which, according to Brandegee, is "pallide purpurea," thus hardly contrasting significantly with the "fine rose-colour" described by Bentham. The type-specimen is well within the ordinary range of variation of *T. nitens* which seems to have been otherwise unrepresented in Brandegee's herbarium.

30. **Tephrosia hypoleuca** Riley

Tephrosia hypoleuca Riley, Kew Bull. **1923:** 339. 1923, not *Cracca hypoleuca* (Boiss.) Alef. 1861, or *C. hypoleuca* Rydb. 1923. "Sierra Madre," (Sinaloa, Durango or Nayarit, between the cities of Mazatlán and Durango or Durango and Tepic), Mexico, *Seemann 2192*, Nov. 1849–Feb. 1850 (K-Type).

Erect perennial, the base and roots unknown; stems sulcate, 3 mm. in diameter 3 dm. below the apex, monopodial. Stems, petioles, rachises, petiolules and pedicels densely strigillose to ascending-hirtellous with fine white or somewhat rusty hairs. Leaves 3.5–9.5 cm. long, the petioles 2–15 mm. long, the rachises 0–1.5 cm. long, deeply channeled on the upper side; stipules deciduous or easily broken; leaflets of the principal leaves 3–7, oblanceolate, acute or obtuse, a few slightly retuse, mucronulate, principally 2–7.5 cm. long, (5–)7–19 mm. wide, the terminal leaflet the largest; leaflets coriaceous, strigillose with very fine white hairs above when young, appearing somewhat canescent, becoming glabrous or nearly so and shining; leaflets densely white-strigillose below, dull to silky in appearance, the veins prominent; petiolules 2–4 mm. long. Inflorescences terminal or axillary, 3–9 cm. long, the peduncle 0.5–2 cm. long, the flowering nodes 5–10; buds ca. 5 or 6 at a node, 3–5 flowering. Primary bracts lanceolate, acuminate, 7–13 mm. long, 1.5–2 mm. wide, apparently deciduous, densely hirtellous; secondary bracts linear-lanceolate, up to 10 mm. long. Pedicels 5–11 mm. long, ascending, thickening to 1 mm. in fruit. Dried flowers 25–30 mm. long. Calyx campanulate, 8–9 mm. long, densely strigillose to ascending-hirtellous with fine white or (along the margins) rusty hairs, the upper lobes deltoid-acuminate, ca. 4 mm. long, the lateral and lowermost with deltoid bases, subulate, 6–7 mm. long. Corolla in dried specimen brownish with a tinge of lavender, the banner apparently with a

green spot near the base; banner 33 mm. long, the blade nearly orbicular, 28 mm. wide, emarginate at the apex, tapering into a narrow claw, densely appressed-hirtellous with golden hairs on the back; wings 29 mm. long, 14 mm. wide, the base of the blade truncate, not auricled, the slender claw 4 mm. long; keel scimitar-shaped, 29 mm. long, 11 mm. wide, the apex rounded, the base narrowed into a slender claw ca. 5 mm. long, exauriculate. Staminal tube 20 mm. long, the vexillary stamen apparently coherent with the tube, free at the base, with a prominent 3-lobed knob-like projection on the upper side near the base. Ovary 20 mm. long, appressed-hirtellous, the style 12 mm. long, barbate on the inner side. Legume curving slightly upward, ca. 8 cm. long, 6–7 mm. wide, compressed, densely hirsutulous with antrorsely directed rusty and white hairs, the overall effect rusty; seeds 12–13, the mature seeds unknown.

Distribution. Southern Sinaloa and probably adjacent Nayarit, Mexico.

Specimens examined. MEXICO. Sinaloa: Quebrada, Municipalidad Concordia, 1500 m., *M. P. Dehesa 1559*, Sept. 1919 (K, US), *Ortega 287* (MEXU). Sinaloa, Durango or Nayarit: Sierra Madre, *Seemann 2192* (K).

Although poorly known, *Tephrosia hypoleuca* is a handsome, distinctive species with 3–7 oblanceolate, coriaceous leaflets, large flowers and deltoid calyx-lobes. It should not be confused with *Cracca hypoleuca* Rydb. (1923), based on *Indigofera Perriniana* Spreng. (1821). The latter plant is a *Tephrosia* of the glabrous-styled series and seems to represent, moreover, only a casual introduction of the African species, **T. linearis* (Willd.) Pers., into the West Indies, where it has not been recollected.

31. **Tephrosia vernicosa** sp. nov.

Planta perennis herbacea vel suffruticosa, 3–5 dm. alta. Folia 4–9 cm. longa; petioli (2–)5–10 mm. longi; stipulae lineari-acuminatae deciduae, 8–10 mm. longae, 1–1.5 mm. latae; foliola foliorum praecipuorum 5–9, angustato-lanceolata, medio latissima, vel leviter oblanceolata, basi et apice acuta, mucronata, foliola superiora folii (23–)35–62 mm. longa, (7–)9–14 mm. lata, inferiora 20–42 mm. longa, 6–10 mm. lata; foliola tenuia firma, supra vernicosa, glabra vel nervus primarius breve strigosus, subtus dense strigillosa pilis cinereis nitidis. Inflorescentiae praecipuae terminales compactae subcapitatae, 2–3 cm. longae, pedunculis 5–7 mm. longis; nodi floriferi circa 6–8, alabastra circa 5 per nodum. Bracteae primariae lineari-lanceolatae, acuminatae, 8–11 mm. longae, 1.5 mm. latae, deciduae. Pedicelli 8 mm. longi, densissime hirsuti vel villosi. Calyx circa 12 mm. longus densissime hirsutus vel villosus pilis cinereis vel ferruginosis; lobi laterales et lobus infimus ovato-deltoidei, abrupte acuminati, attenuati; lobi superiores 6–7 mm. longi, lobi laterales 7–8 mm. longi, lobus infimus 6–7 mm. longus. Lamina vexilli suborbicularis, 15–16 mm. alta lataque, ungue 5 mm. longo; alae 15 mm. longae, 5 mm. latae, leviter auriculatae, ungue 4 mm. longo; carina 13 mm. longa, 8 mm. profunda, auriculata, ungue 4 mm. longo. Tubus staminalis circa 13 mm. longus; stamen vexillare tubo connatum, basi liberum. Ovarium dense strigosum; ovulae 7; stylus barbatus. Legumen seminaque incognita.

Erect herbaceous or suffruticose perennial, 3–5 dm. high, from a woody crown and root; stems terete below, somewhat ridged and sulcate above. Stems, petioles, rachises and axes of inflorescences densely strigillose and with longer ascending cinereous and/or tawny hairs. Leaves 4–9 cm. long, the petioles (2–)5–10 mm. long, much shorter than the lowermost leaflets, the rachis 1–2.5 cm. long; stipules linear, acuminate, deciduous or easily broken, 8–10 mm. long, 1–1.5 mm. wide; leaflets of the principal leaves 5–9, narrowly lanceolate, tapering to both ends or slightly oblanceolate, the base acute or cuneate, usually narrower than the acute apex, mucronate, the upper leaflets (23–)35–62 mm. long, (7–)9–14 mm. wide, (3–)4–5 times as long as broad, the basal pairs 20–42 mm. long, 6–10 mm. wide, 3–4 times as long as broad; leaflets thin but rigid, shining as though varnished, glabrous except the short-strigose impressed midrib, at length glabrate above, densely strigillose below with lustrous cinereous or (along the midrib) rusty hairs; petiolules 1–1.5 mm. long. Inflorescences principally terminal, very compact, almost capitate, 2–3 cm. long, the peduncle 5–7 mm. long, the flowering nodes crowded, probably 6–8, short poorly-developed axillary inflorescences 1–3 cm. long sometimes present in the upper axils; buds ca. 5 at a node, ca. 3 flowering. Primary bracts linear-lanceolate, long-acuminate, 8–11 mm. long, 1.5 mm. wide, deciduous; secondary bracts linear-attenuate, ca. 6–8 mm. long. Pedicels ca. 8 mm. long, ascending. Dried flower 18 mm. long. Pedicels, calyx and bracts very densely hirsute to villous with soft cinereous or (near the ends of the calyx lobes) rusty hairs. Calyx ca. 12 mm. long, the lateral and lowermost lobes deltoid-ovate at the base, abruptly narrowed and long-attenuate, the upper lobes 6–7 mm. long, the lateral and lowermost 7–8 mm. long, ca. 2.5 mm. broad at the base. Corolla color unknown, pinkish-brown in dried specimen; blade of the banner suborbicular, 15–16 mm. high, 15–16 mm. broad, tapering into a claw 5 mm. long, the blade hirsute or villous on the back with fine silky rusty and cinereous hairs, wings ca. 15 mm. long, 5 mm. broad, slightly auriculate, the claw 4 mm. long; keel 13 mm. long, 8 mm. deep, auriculate, the claw 4 mm. long. Staminal tube ca. 13 mm. long, the vexillary stamen coherent with the tube, free at the base, with a prominent 2-lobed callosity on the upper side near the base. Ovary densely strigose, the style barbate, ovules 7. Legume and seeds unknown. Fig. 4, Plate 1153.

Distribution. Known only from the type-locality. Map 16.

Specimens examined. MEXICO. Guerrero: "Shrub, 30 cm., local, pine forest," Laguna–Tequeches, 1950 m., Dist. Mina, *G. B. Hinton 9950*, 3 Dec. 1936 (NY-Type; GH, UC).

Although it is known from only a single collection, *Tephrosia vernicosa* is so completely distinct that it is not likely to be confused with any other American species. The 5–9 lanceolate leaflets tapering to both ends, the upper surfaces shining as though varnished and the lower surfaces densely strigillose, the

much-condensed, congested inflorescences, and the characteristic hirsute or villous calyx with attenuate lobes 6–8 mm. long immediately differentiate it. The legume and seeds are unknown, but the few ovules (7 in the single ovary available for dissection) indicate that additional diagnostic characters may perhaps be found there.

The calyx and congested inflorescences suggest *Tephrosia pogonocalyx*, another new species also known only from a single collection, but the vegetative characters of that plant are quite different. The leaflets in shape and number approach most nearly *T. hypoleuca* of Sinaloa but the resemblance is otherwise not very striking, the flowers being very dissimilar.

The Sierra Madre of Guerrero south of the Río Balsas, from which this new species comes, seems to have been almost untouched except for the collections made by Langlassé, Nelson and Hinton. Nevertheless, eleven species of *Tephrosia* are already known from this area which shares with northern Guerrero, adjacent Morelos and México a total of 17 species, indicating that this region is one of the important centers of diversification of the genus.

32. **Tephrosia pogonocalyx** sp. nov.

Planta perennis erecta herbacea(?), 1 m. alta, undique hirtella vel hirsutula. Folia praecipua 7–13.5 cm. longa; petioli 1–17 mm. longi; stipulae deciduae; foliola foliorum praecipuorum 5–13, elliptica vel angustato-elliptica, basi et apice rotundata vel acuta, 22–43 mm. longa, 11–18 mm. lata, tenuia, supra hirtella vel hirsutula pilis fulvis, subtus hirsutula pilis cinereis, venis conspicuis. Inflorescentia "paniculata," circa 25 cm. longa, nodi floriferi ramorum 3–15, conferti, alabastra circa 4–5 per nodum. Bracteae primariae angustae prope subulatae, attenuatae, 6–11 mm. longae, deciduae; bracteae secundariae lineari-acuminatae, 5–6 mm. longae, deciduae. Pedicelli circa 8 mm. longi, hirsuti vel hirsutuli. Calyx campanulatus 10–12 mm. longus, hirtus vel hirsutulus pilis ferruginosis vel fulvis divaricatis; lobi superiores deltoidei attenuati, 5–7 mm. longi; lobi laterales lanceolati acuminati attenuati, 6–7 mm. longi; lobus infimus 7–9 mm. longus; bracteolae 1 vel 2, lineari-setaceae, circa 5 mm. longae, hirsutae vel hirsutulae. Corolla roseo-purpurea (?); vexillum basi macula viridia, lamina suborbicularis, 15 mm. alta, 16 mm. lata, extus hirsutula; alae 16–17 mm. longae, 6 mm. latae, auriculatae, ungue 3–4 mm. longo; carina 17 mm. longa, ungue 3–4 mm. longo. Tubus staminalis 13–14 mm. longus; stamen vexillare tubo connatum, basi liberum. Ovarium dense strigosum, 9-ovulatum; stylus barbatus. Legumen immaturum hirsutum pilis fulvis.

Erect herbaceous(?) perennial, 1 m. high; stems nearly terete or somewhat angular, striate. Stems, petioles, rachises and axes of inflorescences densely hirtellous to hirsutulous with tawny or cinereous spreading hairs. Principal leaves 7–13.5 cm. long, much reduced in size at the inflorescence,

2–7 cm. long, the petioles 1–17 mm. long, the rachis 3–9.5 cm. long; stipules deciduous; leaflets of the principal leaves 5–13, elliptic or narrowly so, the base and apex either rounded or acute, the apex mucronate, 22–43 mm. long, 11–18 mm. wide, 2–3 times as long as broad, the leaflets of the uppermost leaves (subtending axillary inflorescences) (5–)9–35 mm. long, (2–)5–10 mm. wide, 2–3 times as long as broad; leaflets thin, evenly hirtellous or hirsutulous above with short tawny hairs, moderately hirsutulous below with ascending cinereous hairs, the veins conspicuous on both surfaces; petiolules 1–2 mm. long. Inflorescence "paniculate", composed of a crowded terminal inflorescence with 3–4 short branches 2–3 cm. long from the axils of the upper leaves, the axillary inflorescences reduced in size upward, the longest ca. 13 cm., the flowering portion of the plant ca. 25 cm. long, the flowering nodes 3–15 per branch of the inflorescence, crowded; buds 4–5 at a node. Primary bracts very narrow, almost subulate, attenuate, 6–11 mm. long, deciduous. Pedicels ca. 8 mm. long, ascending. Dried flowers ca. 20 mm. long. Bracts, pedicels, calyx and bracteoles densely hirsute or hirsutulous with spreading rusty or tawny hairs. Calyx campanulate, 10–12 mm. long, with 1 or 2 linear-setaceous bracteoles ca. 5 mm. long at the base or on the pedicel, the upper lobes of the calyx deltoid, attenuate, 5–7 mm. long, the lateral and lowermost lanceolate, long-acuminate, attenuate, 6–7 mm. long and 7–9 mm. long, respectively. Corolla apparently rose-purple with a green spot at the base of the blade of the banner; blade of the banner subquadrate or suborbicular, 15 mm. high, 16 mm. broad, hirsutulous with rusty hairs on the back, with a broad claw 4 mm. long; wings 16–17 mm. long, ca. 6 mm. wide, auriculate, the claw 3–4 mm. long; keel 17 mm. long, 7–8 mm. deep, slightly auriculate, the claw 3–4 mm. long. Staminal tube 13–14 mm. long, the vexillary stamen coherent with the tube, free at the base, with a callosity on the upper side near the base. Ovary densely strigose, the style barbate; ovules 9. Very immature legume hirsute with tawny hairs, the mature legume and seeds unknown. Fig. 3, Plate 1153.

Distribution. Known only from the type-locality. Map 21.

Specimens examined. MEXICO. México: "One meter high," oak woods, Nanchititla, Dist. Temascaltepec, *G. B. Hinton 3101*, 6 Jan. 1933 (GH-Type; NY).

The densely hirsute calyces brought close together in the rather congested inflorescences suggest *Tephrosia vernicosa*, but this plant is abundantly distinct from that species in its 5–13 membranous, elliptic or narrowly elliptic leaflets and in the presence of bracteoles on pedicels or calyces. Although the single collection leaves much to be desired, this species is so clearly marked by calyces, leaflets, deciduous bracts, crowded inflorescences, and bracteoles that I do not hesitate to describe it.

33. **Tephrosia belizensis** Lundell

Tephrosia chrysophylla Mart. & Gal. Bull. Acad. Brux. **10**(2): 49. 1843, not Pursh, 1814. "On trouve cette Tephrosie dans les savanes a malpighiacées de Zacuapan et de Mirador, à 3000 pieds,"[1] Veracruz, Mexico, *H. Galeotti 3326* (F-leaflet of isotype ex Herb. Mus. Paris.).

Tephrosia belizensis Lundell, Bull. Torr. Club. **64:** 550. 1937. Open rocky bank of Río Frio near San Agustin, Mountain Pine Ridge, El Cayo Dist., British Honduras, *C. L. Lundell 6662*, 29 July 1936 (NY, US).

Slender erect herbaceous or suffrutescent perennial 0.4–2 m. high. Stems, petioles, rachises and axes of the inflorescences strigillose to hirtellous with rusty or cinereous hairs, occasionally with scattered longer hairs. Leaves ascending or spreading, principally 8–24 cm. long, sessile or with petioles only 1–3 mm. long, the rachis 3.5–15 cm. long; stipules linear-subulate, 5–6 mm. long, ca. 1 mm. wide, deciduous; leaflets 5–19, the upper pairs lanceolate or ovate-lanceolate, 2–7.5 cm. long, 0.7–2.5 cm. wide, the apex acute, acuminate, blunt or slightly retuse, mucronate, the base obtuse or rounded, the lowermost pair of leaflets much reduced, suborbicular to oval or ovate, 1–2.5 cm. long, 0.8–1.5 cm. broad, the two lowermost pairs of leaflets usually crowded; leaflets glabrous, dark green and shining, estomatiferous above, moderately to densely strigillose to short-strigose beneath with silvery or golden hairs, silky, shining; petiolules (1–)2–4 mm. long, densely strigillose to hirtellous. Principal inflorescences terminal or 1 or 2 from the upper axils, leafless, lax, slender, the terminal 10–30 cm. long, often with 1–5 branches 10–20 cm. long from the axils of bracts, the peduncle 4–9 cm. long, the flowering nodes 5–32; buds 5–7 at a node, 3–5 flowering, 1 or 2 fruiting. Primary bracts linear-lanceolate, 5–10 mm. long, deciduous before anthesis. Pedicels 6–9 mm. long, ascending, thickening in fruit, hirtellous with rusty hairs. Dried flowers 13–17 mm. long. Calyx ca. 5 mm. long, hirtellous to strigillose with rusty hairs, the lobes linear-lanceolate to lanceolate, the upper 2 mm. long, the lateral 3–4 mm. long, the lowermost 4–5 mm. long. Corolla apparently lavender or magenta; blade of the banner suborbicular, ca. 14 mm. broad, densely hairy on the back, the claw ca. 3 mm. long; wings 15–17 mm. long, 5–6 mm. wide, the claw ca. 2.5 mm. long; keel ca. 15 mm. long, 6 mm. deep, slightly auricled at the base and beaked at the distal end, the claw 3.5 mm. long. Staminal tube ca. 14 mm. long, the vexillary stamen connate with the tube, free at the base, somewhat thickened on the upper side near the base. Ovary densely strigillose; ovules 9–10. Legumes straight or slightly curved downward near the base, short-beaked, 5–7 cm. long, 6–7 mm. wide, ascending or spreading, hirtellous or sometimes hirsutulous with rusty hairs; seeds 8–10, 3.6–4.2 mm. long, 2.8–3.2 mm. broad, brown to gray, lightly variegated with black. Somatic chromosomes 22. Flowering collections from February to March.

[1] According to Allen (1945, p. 281) Zacuapán is the modern village of Axouacapán. This seems to be a misspelling of Axocuápam or Axocuapan which lies north of Huatusco and approximately 11 km. west of Mirador.

Distribution. Pine and oak forests (20–1000 m.?) from Veracruz to Oaxaca and Chiapas, Mexico, and British Honduras. Map 24.

Specimens examined. MEXICO. Veracruz: Mirador or Zacuapán, *Galeotti 3326* (F-fragment); Zacuapán, *Purpus 16360a*, Mar. 1934 (F); rocky oak forests, Zacuapán, *Purpus 16460*, Apr. 1935 (K); Fortín, *Purpus 8679* (US); Matlaluca, *Liebmann 4650* (part), Jan. 1843 (UC). Oaxaca: Shrub in llanos, Chiltepec and vicinity, 20. m., Dist. Tuxtepec, *Martinez-Calderón 386* (A, MEXU, US); shrub up to 3 ft., oak forests near San José Chiltepec, 100 m., 17° 58′ N, 96° 10′ W, *Schultes & Reko 552*, 10 Apr. 1939 (GH). Chiapas: Under oaks, below Finca Liquidambar toward Palestina, 3000 ft., *Hernandez X. & Sharp X379*, 8 Nov. 1945 (GH).

BRITISH HONDURAS. El Cayo: Erect suffrutescent plant, 40–75 cm., open rocky bank of Río Frio, San Agustin, Mountain Pine Ridge, *Lundell 6662*, July–Aug. 1936 (NY, US); edge of ravine, Mountain Pine Ridge, *Bartlett 11588*, 20 Feb. 1931 (US).

34. **Tephrosia mexicana** sp. nov.

Planta perennis erecta herbacea(?), 6 dm. alta. Caules subflexuosi, hirtelli vel strigillosi pilis fulvis vel ferruginosis. Folia (4–)6–11 cm. longa, petioli 3–10 mm. longi; stipulae lineari-subulatae, 7–8 mm. longae, deciduae; foliola 7–13, superiora lanceolata vel oblongo-lanceolata, apice acuta, mucronata, basi rotundata, 35–65 mm. longa, 9–19 mm. lata, terminale maximum; inferiora minima, elliptica vel lanceolato-ovata, 18–32 mm. longa, 8–15 mm. lata; foliola tenuia, venis conspicuis, supra leviter nitida hirtella vel strigillosa, subtus pallidiora, dense strigillosa vel breve strigosa pilis cinereis. Inflorescentiae terminales et axillares, 8–25 cm. longae, graciles laxae ascendentes, pedunculis 4–6 cm. longis; nodi floriferi 10–35, alabastra circa 3–5 per nodum. Bracteae primariae lineari-subulatae angustatae, 5–6 mm. longae, deciduae; bracteae secundariae 3–4 mm. longae, deciduae. Pedicelli 5–7 mm. longi, graciles, hirtelli vel hirsutuli pilis cinereis. Calyx 4–6 mm. longus, hirtellus vel hirsutulus pilis cinereis vel (lobis) ferruginosis quam 1 mm. brevibus; lobi superiores setacei, 1–2 mm. longi; lobi laterales deltoidei vel ovato-deltoidei, abrupte acuminati, 2.5–3.5 mm. longi, basi 2–2.5 mm. lati; lobus infimus deltoideus vel ovato-deltoideus abrupte acuminatus, 3–4 mm. longus. Corolla roseo-purpurea(?); vexillum basi macula viridia, lamina suborbicularis, 12–13 mm. alta et lata, extus strigillosa pilis ferruginosis; alae 15–16 mm. longae, 5 mm. latae, ungue 3–4 mm. longo; carina 14–16 mm. longa, 5–6 mm. profunda, ungue 3–4 mm. longo. Tubus staminalis 12–13 mm. longus; stamen vexillare tubo connatum, basi liberum. Ovarium dense brevique strigosum; ovulae 6–8. Legumen immaturum hirsutulum pilis fulvis.

Erect herbaceous(?) perennial, at least 6 dm. high; stems terete or somewhat angular, striate, somewhat flexuous. Stems, petioles, rachises and axes of inflorescences moderately to densely hirtellous or strigillose with tawny or rusty hairs. Leaves (4–)6–11 cm. long, the petioles 3–10 mm. long, the rachises (1.5–)4–6 cm. long; stipules linear-subulate, very narrow (0.5–0.7 mm.), 7–8 mm. long, deciduous; leaflets 7–13, the distal pairs lanceolate to oblong-lanceolate, the apex usually acute, mucronate, the base rounded, 35–65 mm. long, 9–19 mm. wide, 3.5–4 times as long as broad, the terminal leaflet largest, the proximal pair of leaflets smallest, elliptic or lance-ovate, 18–32 mm. long, 8–15 mm. wide, 2 times as long as

broad; leaflets thin, the veins conspicuous, slightly lustrous, moderately and evenly hirtellous or strigillose above, paler below, moderately to densely strigillose or short-strigose with lustrous cinereous or (along the veins) rusty hairs, silky; petiolules 1.5–2 mm. long. Inflorescences terminal and axillary, often with 1 or 2 branches from the axils of bracts, or the axillary inflorescences occasionally 2 from the axil of a leaf; inflorescences 8–25 cm. long, the branches 2–10 cm. long, slender, wand-like, curving upward, lax, the 10–35 flowering nodes usually well separated, the peduncles 4–6 cm. long; buds 3–5 at a node, 2 or 3 flowering. Primary bracts linear-subulate, narrow, 5–6 mm. long, ca. 0.5–1 mm. wide, deciduous before anthesis, secondary bracts 3–4 mm. long, deciduous. Pedicels 5–7 mm. long, slender. Dried flowers 13–15 mm. long. Calyx and pedicels hirtellous to hirsutulous with cinereous or (on the calyx-lobes) rusty hairs less than 1 mm. long. Calyx 4–6 mm. long, the upper lobes setaceous, 1–2 mm. long, the lateral and lowermost deltoid or deltoid-ovate, abruptly acuminate, 2–2.5 mm. wide at the base, 2.5–3.5 mm. long and 3–4 mm. long, respectively. Flowers apparently rose-purple, the banner with a green spot at the base; blade of the banner suborbicular, 12–13 mm. high and broad, strigillose with rusty hairs on the back, the claw 3 mm. long; wings 15–16 mm. long, 5 mm. broad, the claw 3–4 mm. long; keel 14–16 mm. long, 5–6 mm. deep, the claw 3–4 mm. long. Staminal tube 12–13 mm. long, the vexillary stamen coherent with the tube, free at the base, with a 2-lobed callosity on the upper side near the base. Ovary densely short-strigose or hirsutulous, the style barbate; ovules 6–8. Mature legume and seeds unknown, the very immature fruit hirsutulous with tawny hairs. FIG. 2, PLATE 1153.

DISTRIBUTION. Known only from the type-locality. Map 24.

SPECIMENS EXAMINED. MEXICO. MÉXICO: Oak woods, Cumbre de Tejupilco, 2000 m., Dist. Temascaltepec, *G. B. Hinton 2698*, 24 Nov. 1932 (GH-Type; NY, UC).

Tephrosia mexicana is reminiscent of *T. belizensis*, a plant of Veracruz, Oaxaca, Chiapas and British Honduras. In addition to their apparent isolation from each other on opposite sides of the Central Plateau, the two species differ in a number of morphological particulars outlined in the accompanying table (p. 346).

35. **Tephrosia Langlassei** Micheli

Tephrosia Langlassei Micheli, Mem. Soc. Phys. et Hist. Nat. Genève **34:** 250. pl. 3. 1903. "Plante de 50 cm., fleurs rouge violet," Sierra Madre, 1750 m., Guerrero, Mexico, *E. Langlassé 798*, Jan. 1899 (GH, US). (Apparently collected in the mountains north of and between Coyuquilla and Nuxco, Dist. Galeana; see discussion under *T. major*.)

Cracca Langlassei (Micheli) Rose, Contr. U. S. Nat. Herb. **12:** 270. 1909.

Erect herbaceous or somewhat suffrutescent perennial, 2.5–5 dm. or more high, branching monopodially. Stems petioles, rachises, petiolules

and axes of inflorescences sparsely to densely hirsute or villous with golden or rusty, spreading or somewhat recurving hairs, not doubly pubescent. Principal leaves 6–20 cm. long, sessile or with petioles to 25 mm. long, the rachis 2–11 cm. long; stipules linear-lanceolate to linear, acuminate, 12–13 mm. long, usually persistent, green becoming brown; leaflets of the principal leaves 5–11, lanceolate to ovate-lanceolate, elliptic-lanceolate or oblong-lanceolate, the base rounded, the apex acuminate or occasionally acute, tipped by the slender excurrent midrib, 1.3–8.5 cm. long, 0.8–2 cm.

	T. mexicana	*T. belizensis*
Petioles	3–10 mm. long.	0–3 mm. long.
Leaflets	7–13, the lowermost pair elliptic or lance-ovate, 18–32 mm. long, 8–15 mm. wide, the 2 lowermost pairs not crowded; leaflets hirtellous or hirsutulous above.	5–19, the lowermost pair suborbicular to oval or ovate, 10–25 mm. long, 7–15 mm. wide, the two lowermost pairs crowded; leaflets glabrous above.
Primary bracts	Linear-subulate, 5–6 mm. long.	Linear-lanceolate, 5–10 mm. long.
Calyx	Upper lobes setaceous, 1–2 mm. long, lateral and lowermost lobes deltoid or deltoid ovate, abruptly acuminate, 2.5–3.5 mm. and 3–4 mm. long, respectively.	Lobes linear-lanceolate to lanceolate, 2 mm., 3–4 mm., and 4–5 mm. long, respectively.
Ovules	6–8	9–10

wide, the lowermost leaflets usually smallest; leaflets thin, usually almost membranous, dark green above, paler beneath, the veins evident, the upper epidermis usually stomatiferous, hirsutulous, the lower surface moderately to densely hirsutulous or hirsute with spreading cinereous or golden hairs; petiolules 1–2 mm. long, slender. Inflorescences terminal and axillary (the latter often 2 from an axil), usually lax, slender, ascending, 4–35 cm. long, leafless or the lowermost node with a leaf, the peduncle 2–10 cm. long, the axis angled, sulcate or striate, the flowering nodes 3–20; buds 3–5 at a node, usually 3 flowering. Primary bracts linear-lanceolate or linear, long-acuminate, 7–18 mm. long, usually green, persistent, 5-veined; secondary bracts linear to linear-setaceous, long-acuminate, 6–13 mm. long, often persistent. Pedicels slender, almost filiform, 10–13 mm. long, scarcely thickening in fruit. Dried flowers 13–15 mm. long. Calyx campanulate, 8–9 mm. long, hirtellous with very fine whitish hairs and hirsute or villous with golden or rusty hairs, the lobes deltoid at the base, subulate-attenuate, the upper lobes 5 mm. long, the lateral 5–6 mm. long, the lowermost 7–7.5 mm. long. Corolla pink or purplish when dry, the banner with a green spot at the base; blade of the banner suborbicular, 12–14 mm. high, 12–13 mm. broad, strigillose or short-strigose on the back

with fine silky hairs, the claw 2–3 mm. long; wings 14–15 mm. long, ca. 6 mm. wide, slightly auricled, the claw 3 mm. long; keel 13–15 mm. long, exauriculate, the claw 3–3.5 mm. long. Staminal tube 10–12 mm. long, the vexillary stamen coherent with the tube, free at the base, with a prominent callosity on the upper side. Ovary strigose with fine soft hairs; ovules 6 or 7. Legume 4–5 cm. long, 6–7 mm. broad, flat, hirsutulous to hirsute with spreading golden or rusty hairs, horizontal or ascending; seeds 5–7, the mature seeds not seen. Flowering collections from January to April.

DISTRIBUTION. Rocky slopes and pineland, 1300–1750 m., Veracruz, Guerrero, Oaxaca and Chiapas, Mexico. Map 17.[1]

SPECIMENS EXAMINED. MEXICO. VERACRUZ: Hillsides, Tecomatla, *Purpus 10028*, Apr. 1927 (F); rare, on moist rocks, barrancas near Tecomatla, *Purpus 10106*, 25 Feb. (US); very rare, rocky slopes, barranca near Tecomatla, *Purpus 10508*, Oct. (US); Tecomatla, *Purpus* (US); rocky hillsides near Tecomatla, *Purpus 10528*, Oct (UC); Matlaluca, *Liebmann 4650*, Jan. 1843 (US). OAXACA: Between Juquila and Nopala, Dist. Juquila, 4000–17000 [7000?] ft., *E. Nelson 2419*, 4 Mar. 1895 (US); between Santa Cruz and Teutila, Dist. Cuicatlán, 1300 m., *Conzatti 3550*, 20 Apr. 1919 (US). GUERRERO: Sierra Madre, 1750 m., [apparently Dist. Galeana; see synonymy above], *Langlassé 798*, Jan. 1899 (GH, US). CHIAPAS: Pineland, Montecristo, *Matuda 1975*, Jan. 1938 (A, F, NY, US).

Tephrosia Langlassei is discussed with the following species.

36. **Tephrosia simulans** sp. nov.

Planta *Tephrosiae Langlassei* affinis perennis erecta herbacea vel suffrutescens, 0.2–2.5 m. alta, undique strigillosa, hirtella vel hirsutula pilis aureis vel cinereis quam 1 mm. brevioribus. Folia praecipua 5–13 cm. longa; stipulae lineari-acuminatae vel lineari-setaceae, 5–7 mm. longae, plerumque deciduae; foliola 5–11, lanceolato-ovata, lanceolata, elliptico-lanceolata, oblongo-lanceolata vel fere elliptica, basi rotundata vel obtusa, apice plerumque acuta vel rotundata, longiuscule mucronata, terminale (2.2–)3–7 cm. longum, (0.7–)1–3 cm. latum, inferiora (1–)1.5–5.5 cm. longa, (0.6–)1–2.5 cm. lata, coriacea, venis conspicuis, supra viridia, nitida, estomatifera, hirtella, subtus pallidiora, hirsutula pilis mollibus cinereis vel aliquando aureis. Inflorescentiae terminales vel axillares, 4–30 cm. longae, erectae vel ascendentes, plerumque efoliatae, pedunculis 2–9 cm. longis; nodi floriferi 3–20. Bracteae primariae lineari-lanceolatae vel lineari-subulatae, plerumque brunneae et deciduae; bracteae secundariae lineari-setaceae, 3–5 mm. longae, deciduae. Pedicelli 7–14 mm. longi. Calyx campanulatus 5.5–7 mm. longus, hirtellus vel hirtellus et hirsutulus vel strigillosus et breve strigosus pilis cinereis, ferruginosis vel atro-brunneis, lobi basi deltoidei vel ovato-deltoidei, acuminati vel subulati, lobi superiores 3–4 mm. longi, lobi laterales 3.5–5(–6) mm. longi, lobus infimus 3.5–5.5(–7) mm. longus. Corolla lilacina; vexillum basi macula viridia, lamina suborbicularis, 12–15 mm. alta et lata; alae 13–16 mm. longae, exauriculatae, ungue 2–2.5 mm. longo; carina 14–15 mm. longa, exauriculata, ungue 2–3 mm. longo. Tubus staminalis 10–12 mm. longus; stamen vexillare tubo connatum, basi liberum. Ovarium dense brevique strigosum, 6–7-

[1] Since Map 17 was drawn the westernmost dot for this species (accompanied by "?") has been located more definitely and should be moved southeastward to Dist. Galeana, Guerrero. See synonymy above and discussion under *Tephrosia major*.

ovulatum; stylus barbatus. Legumen fere maturum 4.5–5 cm. longum, 5–5.5 mm. latum, hirsutulum vel hirsutum pilis cinereis, ferruginosis vel atro-brunneis, semina 6–7; semina immatura circa 4 mm. longa, 2.6 mm. lata.

Erect herbaceous or suffrutescent perennial, 0.2–2.5 m. high, from a woody root; stems terete, striate and purplish below, somewhat angled above, branching monopodially. Stems, petioles, rachises, petiolules and axes of the inflorescences strigillose or hirtellous to hirsutulous with golden or cinereous hairs less than 1 mm. long. Principal leaves 5–13 cm. long, sessile or with petioles up to 15 mm. long, the rachis 2–7 cm. long; stipules linear, acuminate, to linear-setaceous, 5–7 mm. long, brown, usually deciduous; leaflets of the principal leaves 5–11, lanceolate-ovate, to lanceolate, elliptic-lanceolate, oblong-lanceolate or nearly elliptic, the base usually rounded or obtuse, the apex acute or rounded, rarely acuminate, tipped by the slender excurrent midrib, the terminal leaflet largest, (2.2–)3–7 cm. long, (0.7–)1–3 cm. wide, the lateral leaflets (1–)1.5–5.5 cm. long, (0.6–)1–2.5 cm. wide; leaflets coriaceous, shining, dark green above, paler below, the veins prominent, often somewhat impressed above, the upper epidermis estomatiferous, hirtellous, the lower surface hirsutulous with soft cinereous or occasionally golden hairs, often appearing pilose; petiolules 1–2 mm. long. Inflorescences terminal and axillary, the latter often 2 from an axil, 4–30 cm. long, ascending, somewhat lax, leafless or 1 or 2 nodes with a leaf, the peduncle 2–9 cm. long, the flowering nodes 3–20; buds 3–5 at a node, 1–3 flowering. Primary bracts linear-lanceolate to linear-subulate, 5–8 mm. long, usually brown and deciduous; secondary bracts linear-setaceous, 3–5 mm. long, deciduous. Pedicels 7–14 mm. long, usually stouter than in *T. Langlassei*. Dried flowers 14–18 mm. long. Calyx campanulate, 5.5–7 mm. long, hirtellous or both hirtellous and hirsutulous or strigillose and short-strigose with whitish, rusty or dark-brown hairs, the lobes deltoid or ovate-deltoid at the base, acuminate to subulate, the upper 3–4 mm. long, the lateral 3.5–5(–6) mm. long, the lowermost 3.5–5.5(–7) mm. long. Corolla "lilac-purple" (Mexia), the banner with a green spot at the base within; blade of the banner nearly orbicular, 12–15 mm. high and broad, strigillose or short-strigose on the back with fine silky hairs, the claw 2.5–3.5 mm. long; wings 13–16 mm. long, 4.5–5.5 mm. wide, scarcely auricled, the claw 2–2.5 mm. long; keel 14–15 mm. long, exauriculate, the claw 2–3 mm. long. Staminal tube 10–12 mm. long, the vexillary stamen coherent with the tube, free at the base, with a prominent callosity on the upper side near the base. Ovary short-strigose with fine hairs, the style barbate; ovules 6–7. Legume nearly straight, 4.5–5.5 cm. long, 5–5.5 mm. wide, hirsutulous to hirsute with whitish, rusty or dark-brown hairs; seeds 6–7, the immature seeds ca. 4 mm. long, 2.6 mm. wide. Flowering collections from January to March.

Distribution. At altitudes of 1200–1800 m., mountains in the region of San Sebastián in western Jalisco, and probably Sinaloa, Mexico. Map 17.

Specimens examined. MEXICO. Sinaloa: Sterile material, probably this species: Plants 2–2.5 m. high, in moist, shaded places, Mesa de

Bueso, San Ignacio, 1300 m., *Montes & Salazar 844*, 16 May 1919 (US), *Ortega 482* (MEXU). JALISCO: Brushy slope, near San Sebastián, 3850–5000 ft., *E. W. Nelson 4074*, 16–19 Mar. 1897 (NY, US), *4082* (NY, US); roadside between San Sebastián and the summit of the mountain known as the Bufa de Mascota, 5000–6000 ft., *Nelson 4097*, 20 Mar. 1897 (NY, US); erect, 1.5 m., thicket near stream, Arroyo Seco, s.w. of San Sebastián, 1500 m., *Mexia 1485*, 15 Jan. 1927 (UC); suffrutescent, erect, on steep, pine-forested hillside, east of Arroyo Santa Gertrudis, San Sebastián, 1500 m., *Ynes Mexia 1520–a*, 18 Jan. 1927 (US 1319581-Type; CAS, DS, GH, MO, NY, UC); herb, streamside, Segundo Arroyo, San Sebastián, Sierra Madre, 1500 m., *Mexia 1552–a*, 22 Jan. 1927 (CAS, GH, MO, NY, UC, US).

Tephrosia simulans is undoubtedly closely related to *T. Langlassei*, with which all of these specimens have been identified, but differs from that species in a number of particulars, the most immediately conspicuous of which is the shorter pubescence of all parts except the legume. *Tephrosia Langlassei* is hirsute or villous in varying degrees with golden or rusty, spreading or somewhat recurving hairs, while *T. simulans* is strigillose or hirtellous to hirsutulous with cinereous, golden, or brown hairs usually less than one millimeter long. The more lustrous, thin but rigid and somewhat coriaceous leaflets which are usually merely acute, instead of acuminate as are the membranous leaflets of *T. Langlassei*, and the lack of stomata in the upper epidermis are additional identifying marks of *T. simulans*. The primary bracts of the new species are generally deciduous and much shorter than the persistent bracts of *T. Langlassei* and the calyx-lobes are somewhat broader, usually shorter, less attenuate, and considerably more variable, at times suggesting those of *T. crassifolia*. Completely mature pods have not been seen, but the material available indicates that those of *T. simulans* are about a millimeter narrower than the legume of *T. Langlassei*. Although in many species pubescence-characters have proved too variable to be of much taxonomic value, in this instance the shorter trichomes of *T. simulans* appear to be a trustworthy point of recognition. Additional field-study of both species is, nevertheless, highly desirable.

37. **Tephrosia quercetorum** sp. nov.

Planta perennis decumbens vel erecta herbacea, 3–6 dm. alta. Folia 7–13 foliolata; foliola oblonga, oblongo-oblanceolata vel lineari-oblonga, raro oblongo-obovata, basi plerumque acuta vel cuneata, apice rotundata vel acuta, mucronata, 17–58(–62) mm. longa, 6–14(–18) mm. lata, tenuia, supra viridia,

nitida, venis conspicuis, glabra vel nervus primarius strigillosus, subtus pallidiora, substrigillosa pilis albidis. Inflorescentiae terminales 6–27 cm. longae, erectae, plerumque efoliatae, pedunculis 2–5 cm. longis, nodi floriferi 4–17. Bracteae primariae lineari-lanceolatae vel lineares, deciduae. Pedicelli 5–13 mm. longi. Calyx 8–12 mm. longus, hirtellus et hirsutulus vel strigillosus vel strigillosus et breve strigosus pilis cinereis, ferruginosis et atrobrunneis; lobi superiores 4–6 mm. longi, lobi laterales 5–8 mm. longi, lobus infimus 6–9 mm. longus. Corolla roseo-purpurea; vexillum basi macula viridia, lamina 16–19 mm. longa, 14–19 mm. lata, extus strigillosa pilis albidis; alae 16–19 mm. longae, auriculatae; carina 16–18 mm. longa, ungue 4–5 mm. longo. Tubus staminalis 12–15 mm. longus; stamen vexillare tubo connatum, basi liberum. Ovarium dense brevique strigosum; stylus barbatus; ovulae circa 9–10. Legumen immaturum circa 4–4.5 mm. latum, hirsutulum pilis cinereis, ferruginosis et atrobrunneis.

Decumbent or erect herbaceous perennial 3–6 dm. high from heavy woody roots and a slender branching crown, the stems several, simple or branched, nearly terete below, striate, angular and sulcate above. Stems, petioles, rachises, petiolules and axes of inflorescences strigillose to short-strigose, or the inflorescences somewhat hirsutulous with cinereous, rusty or dark-brown hairs. Leaves ascending, (4.5–)7–13 cm. long, the petioles 3–16 mm. long, much shorter than the lowermost leaflets, the rachis (2–) 3–7.5 cm. long, both petiole and rachis channeled on the upper side; stipules linear, acuminate, 5–12 mm. long, brown, persistent at least until anthesis; leaflets of the principal leaves (5–)7–13, oblong, oblong-oblanceolate, or linear-oblong, occasionally oblong-obovate, the base generally acute or cuneate, the apex rounded to acute, mucronate, 17–58(–62) mm. long, 6–14(–18) mm. wide, thin but firm, the lateral veins prominent and conspicuously reticulate between, the leaflets bright green, lustrous, glabrous or strigillose along the midrib above, pale below, moderately strigillose to short-strigose with fine whitish hairs, sometimes appearing silvery or canescent; petiolules 1.5–2.5 mm. long. Inflorescences terminal, 6–27 cm. long, ascending or erect, leafless or the lowermost node with a leaf, exceeding the leaves, the axis angular and sulcate, the peduncle 2–5 cm. long, the flowering nodes 4–17; buds 4–6 at a node, 2–4 flowering. Primary bracts linear-lanceolate to linear, long-acuminate, 6–8 mm. long, 1 mm. or less wide, deciduous, brown; secondary bracts linear-filiform, 4–7 mm. long, deciduous. Pedicels 5–13 mm. long, ascending. Dried flowers 18–21 mm. long. Calyx 8–12 mm. long, hirtellous and hirsutulous to strigillose or strigillose and short-strigose with various combinations of cinereous, rusty, and dark-brown hairs, the lobes lanceolate to lance-ovate, long-acuminate, the upper lobes 4–6 mm. long, the lateral 5–8 mm. long, the lowermost 6–9 mm. long. Corolla rose-purple, becoming violet in age, the banner with a conspicuous green spot near the base; blade of the banner suborbicular, 16–19 mm. high, 14–19 mm. wide, strigillose on the back with fine white hairs, the claw 3–4 mm. long; wings 16–19 mm. long, 4.5–5 mm. broad, with an acute auricle, the claw 2.5–4.5 mm. long; keel 13–18 mm. long, 7 mm. deep, the claw 4–5 mm. long. Staminal tube 12–15 mm. long, the vexillary stamen coherent with the tube, free at the base, with a prominent callosity on the upper side near the base. Ovary

densely short-strigose, the style barbate; ovules ca. 9 or 10. Immature legume 4.5 cm. long, 4–4.5 mm. wide, hirsutulous with cinereous, rusty, and dark-brown hairs. PLATE 1154.

DISTRIBUTION. Known only from the mountains in the region of Taxco, Guerrero, Mexico. Map 21.

SPECIMENS EXAMINED. MEXICO. GUERRERO: Oak woods, Chacualco Trail, Taxco, *Ruth Q. Abbott 333*, 12 Aug. 1937 (GH); steep, rocky, acid slopes with huge exposed boulders and ledges in oak woods, Huajajutla, near km. 151–153 on highway above Taxco, ca. 6000 ft. (1800–1900 m.), *H. E. Moore, Jr. & C. E. Wood, Jr. 4547*, 16 Aug. 1948 (GH-Type; MEXU, UC, Bailey Hortorium); north of Iguala, *E. Hernandez X. & E. J. Alexander XA159*, 12 Aug. 1945 (GH, MEXU). .

Tephrosia quercetorum is a handsome plant of well-drained rocky soils in oak woods in the neighborhood of Taxco, Guerrero, Mexico. The usually decumbent habit, the 7–13 thin, lustrous, oblong, oblong-oblanceolate or linear-oblong leaflets with the undersurfaces pale and white-strigillose or short-strigose are distinctive, as are the lanceolate to lance-ovate, long-acuminate calyx-lobes. The calyx is strongly reminiscent of *T. Pringlei* and *T. Watsoniana* and the vegetative characters perhaps approach those of *T. Watsoniana* as closely as any other species. The affinities of *T. quercetorum* are not, however, obvious. The presence of dark-brown hairs in addition to the usual rusty or cinereous pubescence normally encountered in many species is remarkable, but is not a constant feature.

38. **Tephrosia Watsoniana** (Standl.) Macbr.

Clitoria? sericea S. Wats. Proc. Amer. Acad. **22:** 407. 1887. On grassy hillsides, Río Blanco [ca. 10 mi. north by west of Guadalajara], Jalisco, Mexico, *Edward Palmer 321*, Aug. 1886 (GH-Type; MEXU, NY).

Cracca sericea (S. Wats.) Rose, Contr. U. S. Nat. Herb. **12:** 271. 1909, not A. Gray, 1883.

Cracca Watsoniana Standl. Contr. U. S. Nat. Herb. **23:** 472. 1922. Substitute name based on *Clitoria? sericea* S. Wats.

Tephrosia Watsoniana (Standl.) Macbr. Field Mus. Publ. Bot. **4:** 87. 1925, not. *T. sericea* (Thunb.) Pers. 1807, or *T. sericea* Bak. in Oliver, 1871.

Erect or somewhat decumbent perennial, somewhat suffruticose at the base, 1–4 dm. high, from a woody branched crown and heavy woody root; stems clustered, sulcate, angled above, nearly terete below. Stems, petioles, rachises and axes of the inflorescences hirtellous and hirsutulous to strigillose or short-strigose with fine cinereous hairs. Leaves unifoliolate or, on large plants, 1–7-foliolate, principally 3–12 cm. long, the rachis when present 0.7–3 cm. long; stipules linear, acute, to linear-subulate,

5–12 mm. long, 1–1.5 mm. or less wide, brown and persistent; leaflets linear-oblong to oblanceolate, oval or obovate, 20–80 mm. long, 9–30 mm. wide, obtuse or rounded at the apex, mucronate, obtuse or rounded at the base, somewhat rigid but thin, green, moderately to densely covered with very fine appressed or ascending hairs above and soft to the touch, appearing canescent, and often glabrate in age; leaflets densely short-strigose or somewhat hirsutulous and silvery below with fine hairs, sericeous and soft, the veins prominent, conspicuously reticulate between the principal laterals; petiolules 1–4 mm. long. Inflorescences terminal, erect, leafless (or the lowermost node with a leaf), few-flowered, 5–24 cm. long, the peduncle 2–10 cm. long, the flowering nodes 2–11; buds 4–5 at a node, 1–3 flowering, 1 or 2 fruiting. Primary bracts linear-lanceolate to subulate, 5–10 mm. long, 1.5 mm. or less wide, brown, persistent; secondary bracts subulate, 3–5 mm. long. Pedicels 5–12 mm. long, slender, ascending. Dried flowers 15–20 mm. long. Calyx 6.5–9.5 mm. long, hirtellous and hirsutulous to strigillose and short-strigose with cinereous and/or rusty hairs, the lobes narrowly triangular and short- or long-acuminate, to subulate-attenuate, the upper lobes 2.5–6 mm. long, the lateral 4–7 mm. long, the lowermost 4–7.5 mm. long. Corolla probably rose-purple, with a green spot at the base of the banner, but purple or violet in dried specimens; blade of the banner nearly orbicular, 13–18 mm. high and broad, densely strigillose on the back, the claw ca. 3.5 mm. long; wings 14–16 mm. long, 5–6 mm. wide, auricled, the claw ca. 3 mm. long; keel 15–17.5 mm. long, 6.5–8 mm. deep, the claw 2.5–3.5 mm. long. Staminal tube 10–12 mm. long, the vexillary stamen coherent with the tube, free at the base, thickened on the upper side near the base. Ovary densely strigillose. Legumes spreading or ascending, 3–5 cm. long, 5–5.5 mm. wide, hirtellous to strigillose with cinereous and/or rusty hairs; seeds 6–7, the mature seeds not seen.

Distribution. Open hillsides, oak and pine woods, 1500–2100 m., Nayarit, Jalisco, and western Guerrero, Mexico. Map 21.

Specimens examined. MEXICO. Nayarit: In the Sierra Madre near Santa Teresa, *Rose*, 10 Aug. 1897 (US); Sierra Madre between Santa Gertrudis and Santa Teresa, *Rose 2110*, 8 Aug. 1897 (GH, NY, US). Jalisco: Grassy hillsides, Río Blanco, *Palmer 321*, Aug. 1886 (GH, NY); near Guadalajara, *Rose & Painter 7477*, 30 Sept. 1903 (US); granitic hills near Guadalajara, 5500 ft., *Pringle 9736*, 10 July 1902 (GH, NY, US); rocky hills near Guadalajara, *Pringle 4449*, June–July 1895 (GH, NY, US); rocky mountain slopes with open oak woods, vicinity of Arenal on highway from Guadalajara to Tequila, 5300 ft., *Moore & Wood 4835*, 31 Aug. 1948 (GH, UC, Bailey Hortorium). Guerrero: Between Ayusinapa and Petatlán, 5000–7000 ft., *Nelson 2130*, 14 Dec. 1894 (US).

This attractive species is one of three Tephrosias in which the leaves are normally unifoliolate, although on large plants of this species some leaves may be 3- or even 7-foliolate. The unifolio-

late condition presumably has been derived independently in all three instances, for the other two species, *T. platyphylla* and *T. madrensis*, are not closely related either to *T. Watsoniana* or to each other.

39. **Tephrosia crassifolia** Benth.

Tephrosia crassifolia Benth. Bot. Voy. Sulph. 80. 1844. Acapulco, Guerrero, Mexico, *Hinds*, 1842 (K-Type).

Cracca crassifolia (Benth.) Kuntze, Rev. Gen. **1:** 174. 1891.

Cracca axillaris M. E. Jones, Contr. West. Bot. **15:** 137. 1929. "Among the live oaks," El Tigre Mine, Acaponeta, Nayarit, Mexico, *M. E. Jones 23022*, 1 Mar. 1927 (POM-Type; F, GH, UC, US).

Tephrosia lanata var. *velutina* (Rydb.) Macbr. Field Mus. Publ. Bot. **4:** 87. 1925, probably as to plant, not as to name. Based on *Cracca velutina* Rydb. (= *T. pachypoda* Riley) of which the type-collection (*Lamb 575*, Zopilote, Nayarit) is a mixture of *T. pachypoda* and *T. crassifolia*. See Morton, Contr. U. S. Nat. Herb. **29:** 101. 1945.

Cracca lanata Mart. & Gal. sensu Rydb. N. Amer. Fl. **24:** 171. 1923, as to material from Sinaloa and Guerrero, Mexico.

Erect or sprawling herbaceous or shrubby perennial 1–2 m. high. Stems, petioles, rachises, petiolules and axes of inflorescences moderately to densely hirtellous or hirtellous and hirsutulous with spreading rusty hairs, the inflorescence sometimes strigillose. Leaves spreading, (5–)8–17 cm. long, the petioles 5–26 mm. long, shorter than the lowermost leaflets of a leaf, the rachis 2–7 cm. long; stipules linear-acuminate, ca. 8 mm. long, 1.5 mm. wide, deciduous; leaflets of the principal leaves 5–9, the terminal leaflet largest, 4.5–7 cm. long, 2–4 cm. wide, elliptic, elliptic-obovate or somewhat rhombic, the lowermost leaflets smallest, 1.5–4 cm. long, 1.2–2.7 cm. wide, oval to ovate or elliptic, the base of the leaflets obtuse, somewhat cuneate or rounded, occasionally subcordate, the apex obtuse or rounded, occasionally retuse, with a short mucro; leaflets coriaceous, overlapping each other, dark green above, the margins wavy, the veins impressed, the surface evenly hirtellous with fine tawny hairs 0.4–0.6 mm. long, or with additional scattered hairs 1 mm. long, soft to touch, glabrate in age, lustrous; leaflets hirtellous beneath with tawny or rusty hairs, especially along the veins, velutinous. soft, the veins conspicuous, reticulate between the principal lateral veins; petiolules 2–4 mm. long. Inflorescences axillary, solitary or with 1 or 2 shorter inflorescences or subdigitate with 1 or 2 branches near the base, slender, ascending, spreading or recurving, 4–15 (–20) cm. long, the peduncle 1–5(–10) cm. long; flowering nodes 5–ca. 25, evenly distributed, not crowded in appearance; buds 5–7 at a node, 3–5 flowering, 1 or 2 fruiting. Primary bracts linear, acuminate, often recurving, 4–6 mm. long, 1 mm. or less wide, deciduous; secondary bracts inconspicuous, 1–3 mm. long, deciduous. Pedicels slender, 4–9 mm. long, spreading or ascending, hirtellous or strigillose. Dried flowers 12–15 mm. long. Calyx cup-like, 4–5 mm. long, hirtellous or strigillose

with rusty (and sometimes cinereous) hairs, occasionally with scattered longer hairs, the tube ca. 3 mm. long, the lobes deltoid, abruptly subulate, the upper lobes 1–2 mm. long, the lateral 1.5–3 mm. long, the lowermost 2–3.5 mm. long. Corolla purple in dried specimens, the banner with a green spot at the base within, densely strigillose with golden hairs without; blade of the banner suborbicular, 11–14 mm. high and wide, the apex retuse, the claw 2–2.5 mm. long; wings 13–15 mm. long, 4–6 mm. wide, slightly or not auricled, the claw 2–2.5 mm. long; keel 13–15 mm. long, slightly or not auricled, the claw 3–3.5 mm. long. Staminal tube 10–11 mm. long, the vexillary stamen coherent with the tube, free at the base, with a conspicuous 2-lobed callosity on the upper side near the base. Ovary densely strigillose. Mature legume not seen, the immature legume nearly straight, resembling that of *T. lanata* in shape, 3–3.5 cm. long, 4–5 mm. wide, hirtellous to hirsutulous with rusty (and sometimes cinereous) hairs, velvety in appearance; seeds 5–7, the mature seeds not seen.

Distribution. Western slopes of the Sierra Madre Occidental, 700–1500 m., from Sinaloa to Guerrero, Mexico. Map 23.[1]

Specimens examined. MEXICO. Sinaloa: Deep, rocky, shady canyon with *otate* and palms, oak forest, 3000 ft., Capadero, Sierra Tacuichamona, *Gentry 5571*, 12 Feb. 1940 (GH) (for exact location, see Gentry 1946a). Nayarit: Zopilote [Zopelote on label of specimen], 2000–3000 ft., *Lamb 575* (part), Feb. 1895 (A, GH, US); among the live oaks, Tiger Mine, Acaponeta, *M. E. Jones 23022*, 1 Mar. 1927 (F, GH, US, UC). Jalisco: Streamside, Hacienda del Otal, San Sebastián, Sierra Madre Occidental, 1500 m., *Mexia 1693-a*, 15 Feb. 1927 (US). Guerrero: Acapulco, *Hinds*, 1842 (K); Sierra Madre, 1400 m., (apparently from the Sierra Madre between and north of Nuxco and San Luis or Coyuquilla, Dist. Galeana; see discussion, *T. major*), *Langlassé 851*, Feb. 1899 (K).

The lax, often spreading, uncrowded inflorescences, the distinctive calyx and shorter pubescence set *Tephrosia crassifolia* apart from *T. lanata* which it resembles in habit, in number, texture, and often shape of leaflets, and in axillary inflorescences. *Tephrosia crassifolia* appears to be a species of the western Sierra Madre from Sinaloa to Guerrero, while the range of *T. lanata* extends along the slopes of the eastern Sierra Madre from Veracruz into Guatemala and Honduras. This geographical break may possibly prove to be less distinct, however, than would appear from the specimens now in herbaria, for during the summer of 1948 sterile plants of a *Tephrosia* 2–3 feet high with 5–9 lustrous, coriaceous leaflets and abundant pubescence were collected on steep grassy slopes with open pine woods and scattered oaks at

[1] Since Map 23 was reproduced the Guerreran locality accompanied by "?" has been determined more definitely and should be moved southeastward to Dist. Galeana. Guerrero.

an altitude of about 3300 feet between Acahuizotla and Agua de Obispo at km. 339–340 on the highway to Acapulco, Guerrero (*Moore & Wood 4693*, GH, UC, Bailey Hortorium). These plants appear to be identical vegetatively with *T. lanata* from Veracruz and may represent that species, in which event this will be another of those plants which cross over from east to west south of the Central Plateau of Mexico.

It is with some misgivings that the name *Tephrosia crassifolia* Benth. is retrieved from the synonymy of *T. lanata* Mart. & Gal. and adopted as the name for the western member of this pair of species. The type-specimen, collected at "Acapulco", Guerrero, in 1842 (probably from some distance inland where pine forests occur), leaves much to be desired. It consists of two branches with numerous inflorescences, one branch bearing very young buds and the other an immature fruit. A second immature fruit is contained in a pocket on the sheet. No flowers are present, although a few calyces remain. As to vegetative characters, this collection resembles *T. lanata* more strongly than it does specimens from western Mexico. The inflorescences and distinctive calyces link this plant with others from the west, however, so that it would appear proper to include it with those from Jalisco and farther north. Unfortunately, the legumes give no additional information here and, although attempts were made to uncover differences in the leaflet-venation and epidermal structure which might make possible the certain identification of sterile specimens, these met with no success.

Should it eventually be proved that the name *Tephrosia crassifolia* is based upon an aberrant specimen of *T. lanata*, a new combination must be based upon *Cracca axillaris* M. E. Jones, which is without doubt quite distinct morphologically and geographically from *T. lanata*. In view of the few specimens now available, of our scanty knowledge concerning large areas of Mexico, and of our consequent lack of good distributional information, it appears better to resurrect *Tephrosia crassifolia* than to perpetrate another new combination.

40. **Tephrosia lanata** Mart. & Gal.

Tephrosia lanata Mart. & Gal. Bull. Acad. Brux. **10**(2): 48. 1843. "Habite les savanes à malpighiacées de Zacuapan, à 3,000 pieds," (appar-

ently the modern town of Axocuapan or Axocuápam, north of Huatusco; see Sp. 33), Veracruz, Mexico, *H. Galeotti 3286*, August.

Cracca lanata (Mart. & Gal.) Kuntze, Rev. Gen. **1:** 175. 1891.

Erect herbaceous to shrubby perennial about 1 m. high, branching monopodially. Stems, petioles, rachises, petiolules, pedicels and calyces densely hirsutulous with grayish to rusty spreading hairs, appearing pilose, the axes of the inflorescences often less densely so. Principal leaves spreading, 7–17 cm. long, the petioles 5–23 mm. long, much shorter than the lowermost leaflets, the rachis 1.1–6 cm. long; stipules lanceolate-deltoid, acuminate, 6–10 mm. long, 2.5–3 mm. wide at the base, persistent but often broken, densely hairy; leaflets of the principal leaves 5–9, the terminal leaflet largest, 3–13 cm. long, 1.5–6 cm. wide, usually elliptic to oblong-elliptic or oblong-ovate, the lowermost leaflets smallest, 1.2–6 cm. long, 0.9–2.8 cm. wide, elliptic to broadly oval or ovate, the base of the leaflets rounded, often subcordate, the apex slightly retuse, rounded or obtuse, with a small hairy mucro ca. 1 mm. long; leaflets coriaceous, the veins somewhat impressed above, hirsutulous with fine tawny hairs, especially along the midrib, often glabrate, lustrous, densely hirsutulous below, especially along the veins, with fine spreading cinereous to tawny hairs, appearing woolly, soft to the touch, the veins prominent, reticulate between the principal laterals; petiolules 1–3 mm. long. Inflorescences axillary, terminating naked or leafy branches, 3–22 cm. long, slender, ascending, shorter or longer than the leaves, sometimes with 1 or 2 branches from the axils of bracts, or with 1 or 2 shorter inflorescences from the same axil, the peduncles 1–10 cm. long, the flowering nodes 5–25, usually crowded; buds 3–5 at a node, 2 or 3 of these flowering, 1 or 2 fruiting. Primary bracts linear-lanceolate (rarely lanceolate), acuminate, 5–10 mm. long, 1–1.5(–2) mm. wide, sometimes persisting but usually deciduous, glabrous within; secondary bracts linear, acuminate, 4–6 mm. long, 0.5–1 mm. wide. Pedicels slender, ascending, 5–10 mm. long. Dried flowers 13–15 mm. long. Calyx 6–9 mm. long, densely hirsutulous, the tube 2.5–3 mm. long, the upper lobes subulate, 3.5–4 mm. long, the lateral and lowermost lobes lance-subulate, attenuate, 4.5–6 mm. and 5.5–7 mm. long, respectively. Corolla rose-purple; blade of the banner sub-orbicular, 12–15 mm. high, 12–14 mm. broad, densely covered with tawny hairs on the back, the claw 2–3 mm. long; wings 13–16 mm. long, 3–5.5 mm. wide, slightly auricled, the claw 2.5–3 mm. long; keel 13–15 mm. long, exauriculate, the claw 3–3.5 mm. long. Staminal tube 10–11 mm. long, the vexillary stamen coherent with the staminal tube, free at the base, with a conspicuous callosity on the upper side near the base. Ovary densely strigillose. Legumes nearly straight, (2.5–)3–4.5 cm. long, 5–6 mm. wide, somewhat rounded at the distal end, short-beaked on the upper side, spreading or ascending, densely hirsutulous with spreading rusty or cinereous hairs up to 1.5 mm. long, pilose; seeds 3–8, oval-reniform in outline, somewhat compressed, 3.6–3.8 mm. long, 2.4–2.8 mm. wide, brown variegated with black. Flowering collections from August to March.

Distribution. MEXICO. Veracruz: Zacuapán, *Purpus 2230*,

Nov. 1906 (GH, MO, NY, UC, US); open forests and plains, Zacuapán, *Purpus 10822*, Oct. 1926 (US); rocky oak forests, Rancho Viejo, *Purpus 10822*, Feb. 1933 or Mar. 1934 (DS, US), *14314*, Apr. 1930 or Mar. 1932 (A, F, UC), *16692*, Mar. 1936 (US), *14004*, Feb. 1931 (F); Mirador, *Liebmann 4647*, Oct. or Nov. 1841 (F); Mirador, 3600–3800 ft., *Sartorius* (US).

GUATEMALA. Chiquimula: Pine forest, Socorro Mt., between Finca San José (1.5 mi. s.e. of Concepción de las Minas) and Montaña Nube (Montaña Volcancitos), 1200–1700 m., *Steyermark 30969*, 1 Nov. 1939 (F). Jalapa: Montaña Durazno, 2 mi. east of San Pedro Pinula, 1400–1900 m., *Steyermark 32997*, 10 Dec. 1939 (A, F). Zacapa: Oak-pine woods along upper reaches of Río Sitio Nuevo, between Santa Rosalía and first waterfall, 1200–1500 m., *Steyermark 42283*, 9 Jan. 1942 (F).

HONDURAS. Cortés: San Pedro Sula, 800 ft., *Thième*, Nov. 1888 (J. D. Smith's Dist. No. 5202) (K, US).

Tephrosia lanata and the preceding species, *T. crassifolia*, appear to be a closely related pair, the one extending from Veracruz to Guatemala and Honduras, the other from Sinaloa to Guerrero. Both are little-branched, suffrutescent plants somewhat woody at the base, with 5–9 large, coriaceous leaflets and axillary inflorescences with the lowermost inflorescences first and best developed. The two species differ in several particulars, of which the features of the calyx are most striking. The calyx of *T. lanata* is 6–9 mm. long, densely hirsutulous, with the lateral lobes lance-subulate, attenuate, and 4.5–6 mm. long, while that of *T. crassifolia* is 4–5 mm. long, hirtellous or strigillose, with the lobes deltoid, abruptly subulate, the lateral lobes only 1.5–3 mm. long.

41. **Tephrosia Abbottiae** sp. nov.

Planta perennis erecta gracilis herbacea vel fruticosa, 3–20 dm. alta, undique dense hirsutula vel aliquantum tomentosa pilis mollibus cinereis vel fulvis. Folia praecipua 9–18 cm. longa; petioli 5–20 mm. longi; stipulae ovatae vel lineari-lanceolatae, 9–15 mm. longae, 3–5 mm. latae, deciduae; foliola foliorum 7–11, angustato-elliptica, oblonga vel oblongo-lanceolata, basi rotundata, apice obtusa, mucronata, foliola superiora folii grandissima, (30–)40–73 mm. longa, (11–)15–22(–24) mm. lata, inferiora saepe elliptica, (17–)27–40 mm. longa, (10–)15–19 mm. lata, firma, aliquantum coriacea, supra hirtella vel hirsutula pilis fulvis, subtus dense hirsutula vel tomentosa pilis cinereis. Inflorescentiae terminales et axillares laxae erectae vel ascendentes, 7–30 cm. longae, pedunculis 5–13 cm. longis; nodi floriferi 3–11, alabastra circa 3–5 per nodum. Bracteae primariae lanceolatae vel lanceolato-ovatae, acuminatae, dense villosae, 16–17 mm. longae, 4 mm. latae, deciduae; bracteae secundariae dense villosae, 12–16 mm. longae, deciduae. Pedicelli 10–20 mm. longae, dense villosae. Calyx campanulatus, 14–16 mm. longus, densissime villosus pilis cinereis vel (lobis) ferruginosis; lobi superiores 3–8 mm. longi; lobi laterales lanceolati acuminati, 10–12 mm. longi; lobus infimus lanceolatus vel lanceolato-ovatus, acuminatus, 11–13 mm. longus; bracteolae 2, lineari-lanceolatae, villosae, deciduae, 5–10 mm. longae. Corolla roseo-purpurea; vexillum basi macula viridia, lamina subquadrata vel suborbicularis, 24–27 mm. alta et lata,

extus hirsutula, ungue 8–10 mm. longo; alae 30–34 mm. longae, 10–11 mm. latae, exauriculatae, ungue 8 mm. longo; carina 32–34 mm. longa, 12–14 mm. profunda, exauriculata, ungue 8 mm. longo. Tubus staminalis 25–27 mm. longus; stamen vexillare tubo connatum. Ovarium dense hirsutum vel villosum pilis ascendentibus, 11–13-ovulatum; stylus barbatus. Legumen lineare, 7–19 cm. longum, 6–7 mm. latum, densissime villosum pilis mollibus avellaneis vel fulvis; semina 9–10(–13?).

Erect herb or slender little-branched shrub, 3–20 dm. high; stems nearly terete below, angled and somewhat sulcate above. Stems, petioles, rachises and axes of inflorescences densely hirsutulous or somewhat tomentose with soft cinereous or tawny hairs. Principal leaves 9–18 cm. long, the petioles 5–20 mm. long, shorter than the lowermost leaflets; stipules ovate to linear-lanceolate, 9–15 mm. long, 3–5 mm. broad, glabrous on the inner surface, usually deciduous; leaflets of the principal leaves 7–11, narrowly elliptic, oblong or occasionally lance-oblong, the base usually rounded, the apex obtuse, mucronate, the outermost leaflets usually largest, (30–)40–73 mm. long, (11–)15–22(–24) mm. wide, 2.5–4 times as long as wide, the basal leaflets smallest, often elliptic, (17–)27–40 mm. long, (10–)15–19 mm. wide, 1.5–2(–2.5) times as long as broad; leaflets firm or somewhat coriaceous, slightly lustrous, velvety to touch, hirtellous to hirsutulous with tawny hairs above, moderately to densely hirsusulous or somewhat tomentose with cinereous or (along the veins) tawny hairs below, the veins inconspicuous, the areoles between the lateral veins nearly isodiametric; petiolules 2–3 mm. long, hirsutulous with tawny or rusty hairs. Inflorescences terminal and solitary in the upper axils, usually leafless or 1 node with a leaf, lax, erect or ascending, the terminal inflorescence 25–30 cm. long, the axillary inflorescences 7–25 cm. long, exceeding the leaves, the peduncles 5–13 cm. long, the flowering nodes 3–11; buds 3–5 at a node, 3 or 4 flowering. Primary bracts lanceolate to lance-ovate, acuminate, 16–17 mm. long, 4 mm. wide, 7-veined, deciduous; secondary bracts lanceolate, acuminate, 12–16 mm. long, deciduous. Pedicels 10–20 mm. long. Dried flowers 27–35 mm. long. Calyx, pedicels, bracts and bracteoles very densely villous with fine soft cinereous or (on the lobes and bracts) tawny or rusty hairs. Calyx campanulate, 14–16 mm. long, the upper lobes 3–8 mm. long, the lateral lobes lanceolate, acuminate, 10–12 mm. long, the lowermost lobe lanceolate or lance-ovate, acuminate, 11–13 mm. long, ca. 4 mm. wide at the base. Calyx or pedicel with 1 or 2 linear-lanceolate deciduous bracteoles 5–10 mm. long. Corolla rose-purple, violet when dry, the banner with a conspicuous green spot at the base of the blade within; blade of the banner subquadrate or suborbicular, 24–27 mm. high and wide, densely hirsutulous with soft ascending cinereous hairs on the back, the claw 8–10 mm. long; wings 31–34 mm. long, 10–11 mm. wide, exauriculate, the claw 6–7 mm. long; keel 32–34 mm. long, 12–14 mm. deep, exauriculate, the claw 8 mm. long. Staminal tube 25–27 mm. long, the vexillary stamen coherent with the tube, free at the base, with a prominent callosity on the upper side ca. 5 mm. from the base. Ovary densely hirsute to villous with ascending hairs, the style barbate; ovules 11–13. Legumes linear, curving slightly upward, 7–9 cm. long, 6–7 mm.

wide, very densely villous with lustrous tan or (along the sutures) tawny or rusty hairs; seeds 9–10(–13?), the mature seeds not seen. PLATE 1155.

DISTRIBUTION. Known only from the type-locality. Map 22.

SPECIMENS EXAMINED. MEXICO. GUERRERO: "Small tree or shrub," Casahuates, Taxco, *Ruth Q. Abbott 189*, 23 Dec. 1936 (fruit) (GH); herb or slender little-branched shrub, 1–6 ft. high (sterile), on sunny oak-wooded slopes between Casahuates and small reservoir at head of waterfall above town on mountain west of Taxco, 6200–6500 ft. (1900–2000 m.), *H. E. Moore, Jr. & C. E. Wood, Jr. 4586*, 17 Aug. 1948 (GH, UC, Bailey Hortorium); preceding locality, *Ruth Q. Abbott*, 20 Oct. 1948 (flower & young fruit) (GH-Type; UC, Bailey Hortorium).

This distinctive new species was collected in fruit in 1936 by Mrs. Gordon C. Abbott, of Taxco, in the mountains above Taxco near the village of Casahuates and sent by her to the Gray Herbarium in 1937 along with numerous other interesting plants from this region, including the first material of *Tephrosia quercetorum*. Although the large, furry calyces and legumes and the few, relatively large leaflets marked it as a new species (so annotated by Dr. I. M. Johnston in 1937), I hesitated in early 1948 to base a description on the single fruiting specimen. Accordingly, Dr. H. E. Moore, Jr. and I, in the course of field-work in Mexico, visited Taxco in August 1948, hoping to collect additional material of both *T. quercetorum* and this species. Mr. and Mrs. Abbott extended to us their kind hospitality, enthusiastically gave us detailed directions for locating the plants, and, when we failed to find flowering material at Casahuates, promised to do their best to obtain specimens later in the year. Their best has been highly satisfactory, for after various frustrations they have succeeded in securing flowering specimens which show this new species to be even more remarkable than appeared from the fruit. The rose-purple flowers are the largest of any American species of the genus and these with the large, densely villous calyces and pods, the deciduous bracteoles, large bracts, and few, large leaflets make this (to my mind, at least) the handsomest and one of the most distinct species in the Americas. It seems highly appropriate that this plant should be associated with the name of its discoverer, RUTH Q. ABBOTT.

The relationships of *Tephrosia Abbottiae* seem to be with *T. platyphylla*, *T. diversifolia*, *T. major*, and *T. pachypoda*, all of which are local species of the western Sierra Madre of Mexico.

It is so distinctive, however, that it is not likely to be confused with any of these plants.

42. **Tephrosia pachypoda** Riley

Tephrosia pachypoda Riley, Kew Bull. **1923:** 230. 1923. "Sierra Madre" (between Mazatlán and Durango or Durango and Tepic, probably in Sinaloa or Nayarit), Mexico, *Seemann 2183*, Nov. 1849–Feb. 1850 (K-Type; GH; NY-photograph of GH).

Cracca pachypoda (Riley) G. Ortega, Apuntes Fl. Indig. Sinaloa (Cat. Sist. Pl. Sinaloa) 15. 1929.

Cracca velutina Rydb. N. Amer. Fl. **24:** 171. 1923, not (Spreng.) Kuntze. 1891. Zopilote [Zopelote on label], Nayarit, Mexico, *F. H. Lamb 575* (in part), Feb. 1895 (NY-Type; MO, DS. US–275488). Material of this collection-number in GH and US (201628) is *T. crassifolia* Benth.

Tephrosia lanata Mart. & Gal. var. *velutina* (Rydb.) Macbr. Field Mus. Publ. Bot. **4:** 87. 1925, as to name but probably not as to plant. See Morton, Contr. U. S. Nat. Herb. **29:** 101. 1945.

Cracca lupinoides M. E. Jones, Contr. West. Bot. **15:** 137. 1939. Among the live-oaks, El Tigre Mine, Acaponeta, Nayarit, Mexico, *M. E. Jones 23016*, 1 Mar. 1927 (POM-Type; GH, NY, UC).

Tephrosia lupinoides (M. E. Jones) Morton, Contr. U. S. Nat. Herb. **29:** 101. 1945.

Erect shrubby perennial 1–2 m. high. Stems, petioles, rachises, petiolules, axes of inflorescences, pedicels and calyces densely tomentose with short somewhat tortuous and often tangled cinereous to rusty hairs, soft, woolly. Principal leaves 11–27 cm. long, the petioles 5–25 mm. long, much shorter than the lowermost leaflets of a leaf, the rachises 5–15 cm. long; stipules narrowly triangular, 9–12 mm. long, 4–5 mm. wide, or the uppermost sometimes ovate, the apex rounded, 5 mm. long, 3 mm. wide, deciduous, brown, densely tomentose without; leaflets of the principal leaves 7–11, the terminal and uppermost pairs largest (4.5–)7–12 cm. long, (1.5–)2–6 cm. wide, elliptic, oblong-elliptic, oblong, elliptic or oval, apex of leaflets obtuse, rounded or slightly retuse, acutish, mucronate, the base obtuse, rounded or subcordate; leaflets thick, coriaceous, very veiny above, the veins often reddish, the margins often wavy and rolled under, the upper surface evenly hirtellous with very fine soft somewhat twisted tawny hairs, glabrate, lustrous, the lower surfaces hirtellous to hirsutulous, tomentose with tawny or rusty twisted hairs, especially along the veins, soft to touch, the veins raised, conspicuous, very numerous between the principal lateral veins; petiolules 3.5–7 mm. long, stout, often 2 mm. thick. Inflorescences terminal and solitary in the upper axils, often wand-like, erect or ascending, usually much exceeding the leaves, leafless, 11–60 cm. long, the peduncle (2–)4.5–14 cm. long, often stout, 1.5–4.5 mm. thick, angled, buttressed below the 15–45 flowering nodes; buds ca. 7–9 at a node, ca. 5–7 flowering, 1–4 fruiting. Primary bracts narrowly deltoid to linear-lanceolate, acuminate, 4–8 mm. long, 1–2 mm. wide, deciduous; secondary bracts 2.5–5 mm. long, less than 1 mm. wide, deciduous. Pedicels 5–9

mm. long, ca. 1 mm. thick, ascending. Dried flowers 15–19 mm. long. Calyx campanulate, 5–7 mm. long, the tube 3–4 mm. long, the lobes abruptly short-acuminate, the upper triangular, 2–3 mm. long, the lateral ovate to ovate-lanceolate, 4–5 mm. long, the lowermost ovate-lanceolate to lanceolate, 4–6.5 mm. long. Corolla apparently purplish or rose, the banner with a green spot at the base; blade of the banner nearly orbicular, 13–15 mm. high, 12–17 mm. broad, densely short-hairy without, the claw ca. 3.5 mm. long; wings 13–17 mm. long, 4–7 mm. wide, slightly auricled, the claw 3 mm. long; keel 12–17 mm. long, ca. 6–7.5 mm. deep, slightly auricled, the claw 3.5 mm. long. Staminal tube (12–)13–15 mm. long, the vexillary stamen coherent with the tube, free at the base and apex, with a conspicuous 2-lobed callosity on the upper side near the base. Ovary densely hirsutulous. Legumes linear, straight or slightly curved downward, 4–6.5 cm. long, 5.5–6 mm. broad, strongly ascending or spreading, densely tomentose with rather tortuous and intertwined tawny or rusty hairs (ca. 1.5 mm. long); seeds (4–)9–11, oblong-oval in outline, plump, 3.8–4.2 mm. long, 2.8–3 mm. broad, reddish brown variegated with black. Flowering collections between November and March.

Distribution. Probably in oak woods, mountains of Nayarit and possibly southern Sinaloa, Mexico. Map 22.

Specimens examined. Sinaloa, Durango or Nayarit: Sierra Madre, [between the cities of Mazatlán and Durango or Durango and Tepic], *Seemann 2183* (GH, K; NY-photograph of GH). Nayarit: Zopilote, 2000–3000 ft., *Lamb 575* (part) (A, DS, MO, NY, US); among the live-oaks, Tiger Mine, Acaponeta, *M. E. Jones 23016* (GH, NY, POM, UC).

Tephrosia pachypoda has the dubious distinction of being known at present from three collections, each of which is a type-series! All three clearly represent the same species which is well marked by the large, coriaceous leaves with 7–11 leaflets and by the long, terminal and axillary inflorescences, the calyx, and the slender, densely tomentose legumes.

43. **Tephrosia major** Micheli

Tephrosia major Micheli, Mem. Soc. Phys. et Hist. Nat. Genève **34:** 251. pl. 4. 1903. El Ocote, 700 m., [apparently in southeastern Dist. Montes de Oca between Petatlán, La Morena and Chuveta], Guerrero, Mexico, *E. Langlassé 716*, 15 Dec. 1898 (GH, US).

Cracca major (Micheli) Rose, Contr. U. S. Nat. Herb. **12:** 270. 1909, not Alef. 1861.

Cracca Micheliana Standl. Contr. U. S. Nat. Herb. **23:** 472. 1922. Substitute for *C. major* (Micheli) Standl.

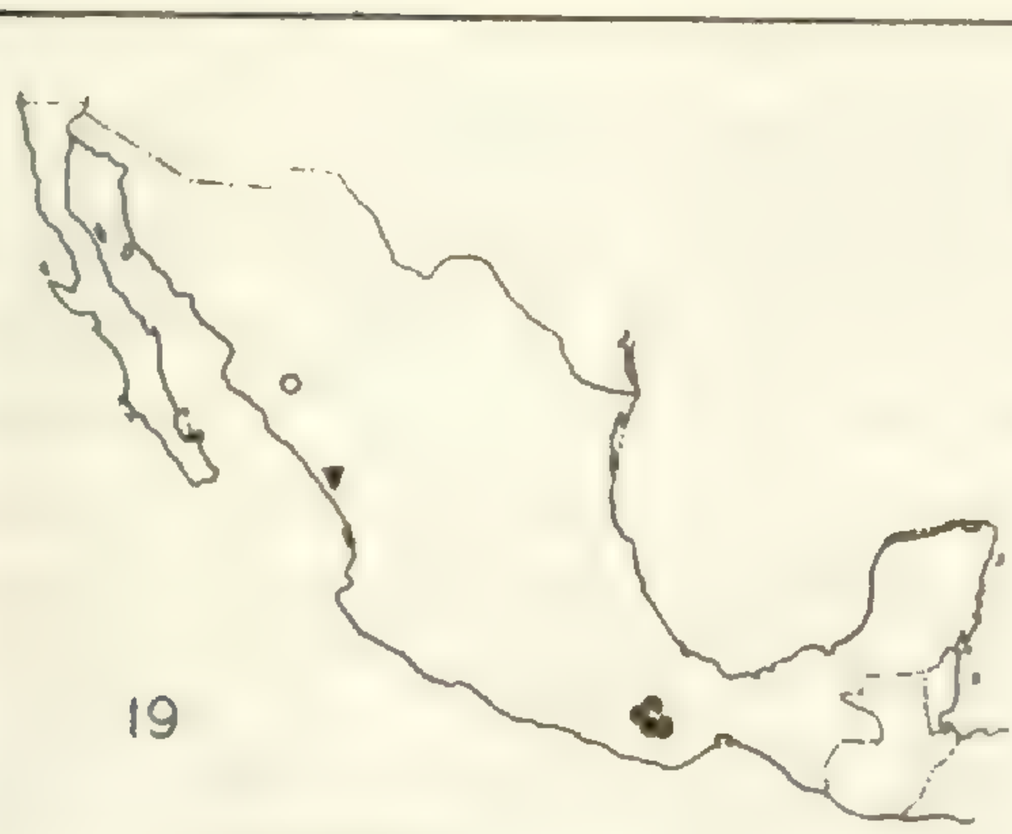
Erect shrubby perennial 1–1.5 m. high; stems rigid, sulcate, angled. Stems, petioles, rachises and axes of inflorescences densely hirtellous-tomentose with grayish, tawny or blackish (soiled), crowded, straight or twisted hairs. Leaves spreading or ascending, 13–20 cm. long, the petiole

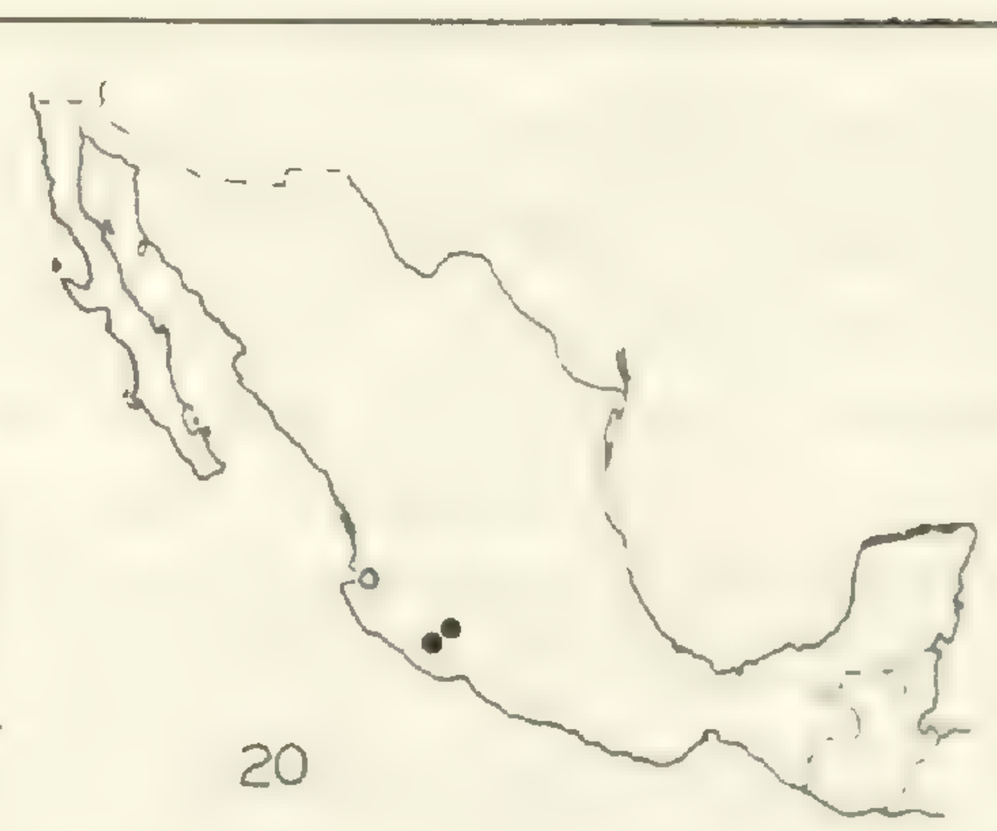
5–13 mm. long, the rachis 3–5.5 cm. long; stipules minute, triangular, ca. 1.5 mm. long, tightly appressed and densely tomentose; leaflets of the principal leaves 3–5 (the uppermost sometimes reduced to 1), elliptic, oblong-elliptic, obovate-oblong, or oval, the base of the terminal leaflet at least acute or cuneate, the others cuneate, acute or rounded, usually obliquely so, the apex obtuse, rounded or retuse, with a small mucro; lowermost leaflets smallest, 4–12 cm. long, 2.2–4.5 cm. broad; leaflets coriaceous, thinly covered above with twisted hairs 0.4–1 mm. long, glabrate and shining except along the principal veins, the veins conspicuous, the principal laterals departing from the midrib almost at right angles, curving upward, the lower surface densely tomentose with short tortuous hairs; petiolules 2–6 mm. long, sometimes 2 mm. thick. Inflorescences terminal or solitary in the upper axils, the terminal 7–45 cm. long, often with 1–3 branches 4–23 cm. long from the axils of deciduous bracts, leafless, erect or ascending, usually exceeding the leaves, angled, sulcate, strongly buttressed below the 5–25 distant flowering nodes, the peduncle 3–13 cm. long; buds ca. 5 at a node, 3 of these flowering, 1 or 2 fruiting. Primary and secondary bracts small, linear-lanceolate, 2–5 mm. long, densely tomentose without, glabrous within, deciduous. Pedicels 5–8 mm. long, ascending, densely tomentose with short, twisting hairs. Dried flowers 18–21 mm. long. Calyx 6 mm. long, densely tomentose with short, rather tortuous cinereous to rusty hairs, the tube 4–4.5 mm. long, the upper lobes acuminate, 1–2 mm. long, the lateral triangular, acuminate, to triangular-lanceolate, acuminate, 2.5–4 mm. long, the lowermost triangular-acuminate to lanceolate, 2.5–6.5 mm. long. Corolla "white tinged with violet" (Langlassé) or rose (Hinton), probably white and becoming rose or violet in age, the banner with a green spot at the base; blade of the banner suborbicular, 15–17 mm. high, 17–19 mm. broad, densely tomentose without, the claw 4–5 mm. long; wings 18–20 mm. long, 6–7.5 mm. wide, auriculate, the slender claw 4–4.5 mm. long; keel 17–18 mm. long, with a short, obtuse beak, the claw 4.5 mm. long. Staminal tube 13–14 mm. long, the vexillary stamen coherent with the staminal tube, free at the base, with a 2-lobed thickening on the upper side. Ovary densely hirsutulous. Legumes stout, nearly straight or slightly curved downward, 4–4.5 cm. long, 6–7 mm. wide, beaked, spreading, densely hirsutulous with nearly straight crowded erect somewhat lustrous cinereous to tan hairs, pilose; seeds (6–)8–9, ca. 4 mm. long, 3 mm. wide, brown variegated with black. Flowering collections in December.

Distribution. Oak forests, 600–700 m., in western Guerrero, Mexico. Map 22.

Specimens examined. MEXICO. Guerrero: Granitic soil, El Ocote, 700 m., [probably in southeastern Montes de Oca between Petatlán, La Morena and Chuveta], *Langlassé 716*, 15 Dec. 1898 (GH, US); oak forest, Sierrita–Palo Solo, Dist. Galeana, 600 m., *Hinton 14998*, 13 Dec. 1939 (GH, NY, PH, TEX, US).

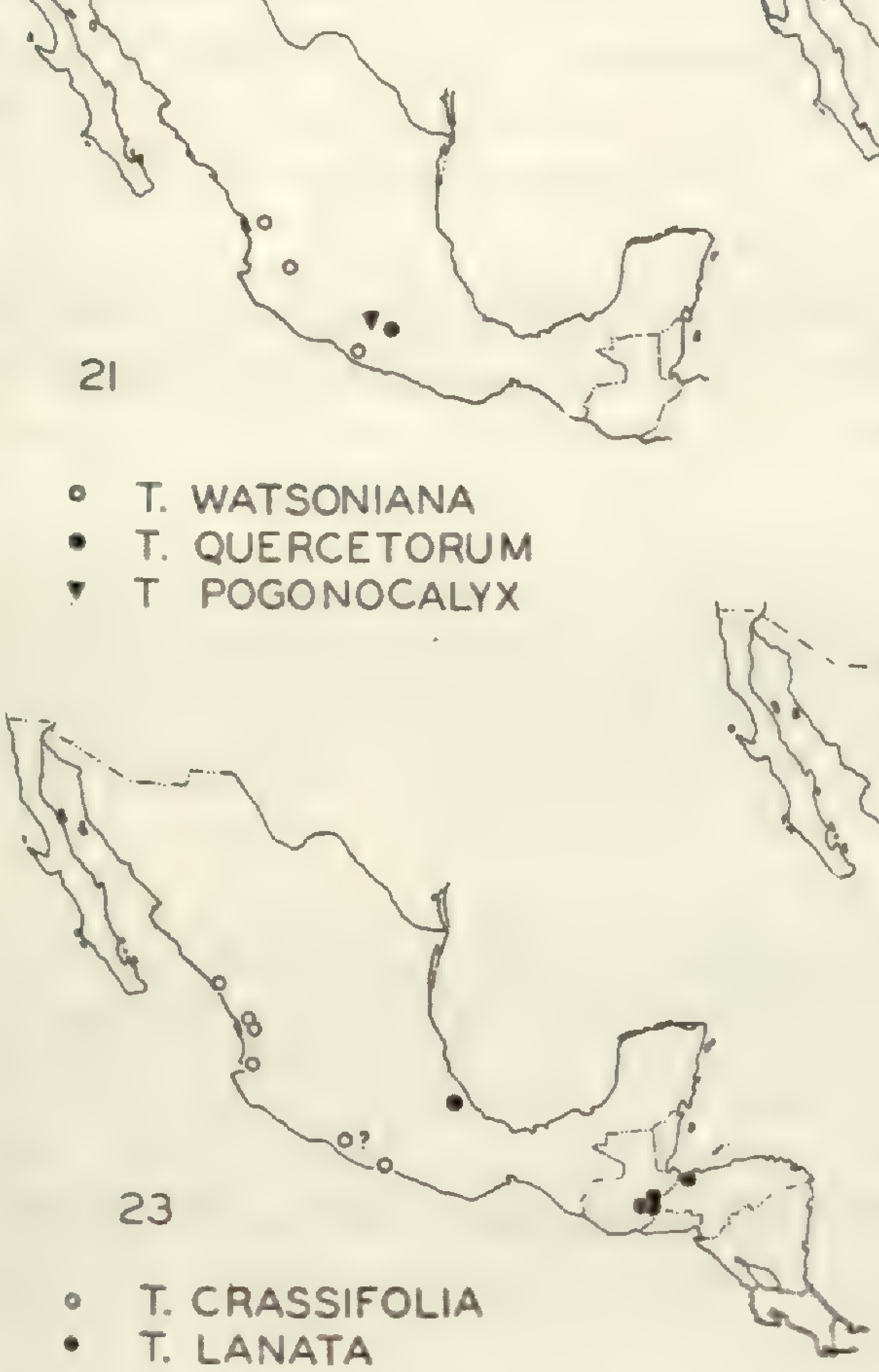
The type-locality of this interesting and very distinct species


19
T. SAXICOLA
T. PRINGLEI
T. SEEMANNII


20
T. PLATYPHYLLA
T. DIVERSIFOLIA

21
T. WATSONIANA
T. QUERCETORUM
T POGONOCALYX

22
T. MAJOR
T. PACHYPODA
T. ABBOTTAE


23
T. CRASSIFOLIA
T. LANATA

24
T. TEPICANA
T. BELIZENSIS
T. MEXICANA

is noted in the description and on the labels of the type-collection merely as "El Ocote". This would appear to be in Michoacán, for Micheli mentions in the same paper *Indigofera excelsa* from "Ocote (Michoacán), 700 m., décembre 1898, n. 696," which was almost certainly collected at the same place as *716*. It seems certain, nevertheless, that both these and other Langlassé collections of *Tephrosia* came from Guerrero rather than Michoacán, for when all of the Langlassé collections cited by Micheli in his *Leguminosae Langlasseanae* (Mem. Soc. Phys. et Hist. Nat. Genève **34:** 245–294. pls. 1–28. 1903) are arranged in numerical sequence, it appears from the dates and localities given that Langlassé's numbers follow, with occasional exceptions (often obviously mistakes), the order of collection and, hence, his journey through Michoacán and Guerrero. Although there are many gaps, enough of the localities given by Langlassé can be located accurately to give an idea both of his route and of the general region from which many specimens labeled with obscure locality-names or merely "Sierra Madre" came. From these data it seems that "El Ocote" lies in the mountains of the southwestern part of Dist. Montes de Oca, Guerrero, somewhere between Chuveta, La Morena and Petatlán. By the use of this same method other Langlassé collections of *Tephrosia* can be located either in Dist. Montes de Oca or Dist. Galeana, Guerrero. *Langlassé 324*, 6 Sept. 1898 (*T. nicaraguensis*) is from Mont de San Cristobal, Valle Grande, easily located on modern maps in Montes de Oca. *Langlassé 596*, Sierra Madre, 1300 m., 7 Nov. 1898 (*T. macrantha*) must have come from the same general region as El Ocote (i. e., between Chuveta, La Morena and Petatlán). *Langlassé 670*, 500 m., 26 Nov. 1898 (*T. nitens*) is from La Botella, near the boundary between Montes de Oca and Galeana. *Langlassé 798*, Sierra Madre, 1750 m., Jan. 1899 (*T. Langlassei*, type-collection) appears to be from the mountains north of and between Coyuquilla or San Luis and Nuxco in Galeana, and *851*, Sierra Madre, 1400 m., Feb. 1899 (*T. crassifolia*) from the same general region.

(To be continued)

CONTRIBUTIONS FROM THE GRAY HERBARIUM OF HARVARD UNIVERSITY—NO. CLXX

THE AMERICAN BARBISTYLED SPECIES OF TEPHROSIA (LEGUMINOSAE)

CARROLL E. WOOD, JR.

(Continued from page 364)

44. **Tephrosia diversifolia** (Rose) Macbr.

Cracca diversifolia Rose, Contr. U. S. Nat. Herb. **12:** 270. fig. 24. 1909. Uruapan, Michoacán, Mexico, *C. G. Pringle 13697*, 14 Nov. 1905 (US 462389-Type; GH).

Tephrosia diversifolia (Rose) Macbr. Field Mus. Publ. Bot. **4:** 87. 1925.

Erect suffrutescent perennial ca. 5–10 dm. high; stems clustered, nearly terete, striate below, obtusely angled, sulcate above, generally herbaceous. Stems, petioles, rachises and axes of inflorescences densely covered with short, fine, twisting cinereous to rusty hairs, soft to the touch. Leaves ascending, 7–13 cm. long, sessile or with petioles 1–4 mm. long, the rachis when present 0.5–2.5 cm. long; stipules triangular to linear, acute or acuminate, 7 mm. or less long, persistent, often recurving; leaflets 1–5, the terminal the largest, oblong to elliptic, the base acute, obtuse, or rounded,

the apex obtuse, rounded, or retuse, mucronulate, 6–10 cm. long, 2.4–4 cm. wide, the lowermost pair of leaflets usually much smaller, suborbicular, oval, ovate or elliptic, the base often oblique, 1.5–4.5 cm. long, 1.6–3.5 cm. wide; leaflets coriaceous, veiny above, at first strigillose with very fine flexuous cinereous to rusty hairs, glabrate or nearly so and shining above, densely white-tomentose below with short, very fine, matted hairs, the veins prominent, the margins undulate, subcrenate; petiolules 1–3 mm. long, ca. 1.5 mm. in diameter. Inflorescences terminal and solitary in the upper axils, 3–30 cm. long, the terminal often paniculate with 1–5 branches 2–17 cm. long from the axils of small deciduous bracts, erect or ascending, leafless, usually exceeding the leaves, the peduncle 1–10 cm. long, the flowering portion dense, short, the flowering nodes 3–ca. 15; buds at a node apparently few to many, probably 2 or 3 flowering. Primary bracts oval to orbicular, 3.5–9 mm. high, 3–8 mm. broad, abruptly short-acuminate, somewhat spathaceous, often persisting, conspicuous, crowded, densely short-tomentose without, reddish and glabrous within. Pedicels 6–9 mm. long, ascending, tomentose. Dried flowers 20–25 mm. long. Calyx 13–15 mm. long, densely hirsutulous-tomentose with somewhat tortuous and tangled cinereous to tawny or dark-brown hairs, the tube 5–6 mm. long, the upper lobes long-acuminate, 5–8 mm. long, the lateral oblong-lanceolate to ovate-lanceolate, obliquely acuminate, 8–11 mm. long, ca. 3.5 mm. wide, the lowermost oblong to oblong-obovate, abruptly short-acuminate, 10–11 mm. long, 5–6.5 mm. wide; calyx with 2 conspicuous broadly (sometimes obliquely) oval bracteoles 8–10 mm. high, 10–15 mm. wide, the apex abruptly short-acuminate or mucronate, the bracteoles caducous, spathaceous, reddish and glabrous within, densely short-tomentose without with cinereous to dark-brown hairs. Corolla violet in recently dried specimens; blade of the banner nearly orbicular to oval, 16–18 mm. high, ca. 21 mm. broad, densely silky hirsutulous-tomentose on the back, broadly cuneate at the base, tapering into a distinct claw ca. 6 mm. long; wings 20–23 mm. long, 7–8 mm. wide, with a rounded auricle, the claw 6–7 mm. long; keel 19–20 mm. long, 7–8 mm. deep, slightly auricled, the claw 7 mm. long. Staminal tube 13–16 mm. long, the vexillary stamen coherent with the staminal tube, free at the base, broad and flattened on the upper surface. Ovary densely appressed-hirsutulous. Legumes nearly straight, short-beaked, (1.5–)3–4.5 cm. long, 8–10 mm. wide (including pubescence), somewhat spreading, very densely hirsutulous with nearly straight, crowded, erect, somewhat lustrous tawny hairs, pilose; seeds (1–)5–6, the mature seeds not seen, the immature seeds nearly orbicular. Flowering collections from November to January.

Distribution. Pine forests, 1700–1800 m., mountains of western Michoacán, Mexico. Map 20.

Specimens examined. MEXICO. Michoacán: Uruapan, *Pringle 13697*, 14 Nov. 1905 (GH, US); mountain-side near Coru Station, 6000 ft., *Pringle 10347*, 26 Jan. 1907 (GH, MEXU, NY, PH, UC, US); shrub 0.75 m. high, pine forest, Puerto Zarzamora, 1740 m., Dist. Coalcomán, *Hinton 12719*, 5 Dec. 1938 (GH).

45. **Tephrosia platyphylla** (Rose) Standl.

Cracca platyphylla Rose, Contr. U. S. Nat. Herb. **12:** 270. fig. 25. 1909. Dry hillsides in pine woods between Mascota and San Sebastián, Jalisco, Mexico, *E. W. Nelson 4062*, 14 Mar. 1897 (US 327035-Type; NY-photograph).

Tephrosia platyphylla (Rose) Standl. Field Mus. Publ. Bot. **4:** 214. 1929.

Stiffly erect suffrutescent perennial 2–6 dm. high; stems from woody crowns, clustered, sulcate, angled. Stems, petioles, and axes of inflorescences densely covered with short fine twisting cinereous to tawny or rusty hairs, soft to touch. Leaves ascending, 4–13 cm. long, the petioles 3–12 mm. long; stipules triangular, oblong or lanceolate, 10 mm. or less long, persistent; leaflets 1 or occasionally 3, elliptic to oblong-elliptic, oval or obovate, the base obtuse to subcordate, the apex rounded, obtuse or retuse, mucronulate, principally (3.3–)4–11.5 cm. long, (2–)2.5–6.5 cm. wide, the paired leaflets when present much smaller than the terminal; leaflets coriaceous, very veiny, the veins impressed above, densely short-strigose with soft flexuous tawny hairs above, appearing silky or woolly, becoming glabrous and shining with age, densely short-tomentose beneath with fine tangled whitish to tawny hairs, hirsutulous along the midrib and principal lateral veins, the margins undulate, often subcrenate or rolled under; petiolules 1–3 mm. long, inconspicuous. Inflorescences terminal, compact, short, 4–8 cm. long, the stout peduncle 1.5–5 cm. long, sometimes bearing 1 or 2 sterile bracts, the flowering nodes 3– ca. 10; buds apparently 2 or 3 at a node. Bracts ovate to nearly circular, gradually acuminate, usually abruptly narrowed at the base, 9–16 mm. long, 4–8 mm. wide, crowded, caducous, glabrous within, densely lanate without. Pedicels 10–12 mm. long, ascending. Dried flowers ca. 20 mm. long. Calyx 10–17 mm. long, densely covered with short tangled hairs and with longer ascending white or (along the margins) rusty hairs ca. 2 mm. long, appearing woolly, the tube ca. 5–6 mm. long, the lobes acuminate, the upper lobes subulate to lanceolate, 5–9 mm. long, the lateral lanceolate, 8–12 mm. long, the lowermost ovate-lanceolate, 9–13 mm. long, 5–6 mm. wide. Corolla "rich rose-red" (Nelson) or "purple" (Mexia); blade of the banner suborbicular, ca. 17–20 mm. high, ca. 21 mm. broad, densely hairy on the back, the claw ca. 6 mm. long; wings ca. 19 mm. long, 8 mm. wide, slightly auricled, the claw 3 mm. long; keel ca. 18 mm. long, 8 mm. deep, with a small basal auricle, the claw 4.5 mm. long. Staminal tube 13–15 mm. long, the vexillary stamen coherent with the tube, free at the base, broad and flattened on the upper side. Ovary ca. 12 mm. long, densely hirsutulous with ascending tawny hairs; ovules ca. 7. Legume and seeds not seen.

Distribution. Open oak and pine forests, mountains in the region of San Sebastián, western Jalisco, Mexico. Map 20.

Specimens examined. MEXICO. Jalisco: Dry hillside in pine woods, roadside between Mascota and San Sebastián, *Nelson 4062*, 14 Mar. 1897 (US); dry, open, oak and pine woods, trail to Tranquillas, Real Alto, Sierra Madre Occidental, 2500 m., *Mexia 1716*, 19 Feb. 1927 (A, CAS, DS, GH, MO, NY, UC, US).

The large, coriaceous, usually unifoliolate leaves and the large, densely hairy calyx without bracteoles are quite characteristic. *Tephrosia platyphylla*, presumably most closely related to *T. diversifolia*, is the most highly modified of the species with few, large, coriaceous leaflets. In this species the reduction of leaflets to one (or three on large plants), of the number of nodes of the inflorescence, of the number of buds at a node, and of size and woodiness of plant seem to have accompanied one another.

Introduced Species

The exotic species naturalized in the Americas, chiefly in the West Indies, include at least *Tephrosia grandiflora*, *T. candida*, **T. noctiflora* and **T. purpurea*. In addition *T. Vogelii* and **T. villosa* have been tested as cover-crops and may be expected to escape from cultivation. Of the barbistyled species only *T. candida* and *T. grandiflora* seem to have become naturalized to any extent. *Tephrosia Vogelii* and *T. bracteolata* are known to me only from one old collection each, and are consequently regarded only as waifs. At least one other species, the African **T. linearis* (Willd.) Pers. (*Cracca hypoleuca* Rydb., *Indigofera Perriniana* Spreng.), is also known as a casual adventive in the New World.

46. **Tephrosia grandiflora** (L'Hér. ex Ait.) Pers.

Galega rosea Lam. Dict. **2:** 599. 1786, not *Tephrosia rosea* F. Muell. ex Benth. 1864. Seen by Lamarck in the garden of M. Cels in August, 1786, and believed by him to have come from Africa.

Colinil rosea (Lam.) Hitchc. Mo. Bot. Gard Rep. **4:** 75. 1893.

Galega grandiflora L'Hér. ex Ait. Hort. Kew. **3:** 70. 1789. "Native of the Cape of Good Hope. Mr. *Fr. Masson*. Introduced 1774." Attributed in synonymy to L'Héritier, Stirp. Nov. **2:** pl. 44, which was never published. According to Forbes (1948, p. 992), the type-specimen, *Aiton*, cult. Hort. Kew., is non-extant.

Tephrosia grandiflora (L'Hér. ex Ait.) Pers. Syn. Pl. **2:** 329. 1807. Basonym mistakenly attributed to Vahl, 1790, who cited Aiton.

Apodynomene grandiflora (L'Hér. ex Ait.) E. Mey. Comm. Pl. Afr. Austr. 111. 1836. Based on *T. grandiflora* (L'Hér. ex Ait.) Pers.

Cracca grandiflora (L'Hér. ex Ait.) Kuntze, Rev. Gen. **1:** 175. 1891. Basonym incorrectly attributed to Vahl.

Apodynomene Meyeri C. Presl, Bot. Bemerk. 57. 1844. Based on *A. grandiflora* E. Mey. which Presl believed to differ from true *Tephrosia grandiflora*, although Meyer clearly indicated the nomenclatural basis of the name. Neither description is diagnostic.

Woody perennial 5–6 dm. high from a slender tap-root with numerous branches, or a shrubby plant 2 m. high; stems erect, monopodial with axillary branches 6–20 cm. long, often woody below, the bark buff-colored, the stems often dark above. Stems, petioles and rachises strigillose with fine white or rusty hairs. Leaves 3–8 cm. long, the petiole 4–18 mm. long, usually shorter than the lowermost leaflets, the rachis 1.5–6.5 cm. long; stipules ovate, acuminate, 5–10 mm. long, 3–5 mm. wide, persistent, conspicuous, reddish or brownish, 9–13-veined, sparsely strigillose; leaflets of the principal leaves 9–15, oblanceolate to oblong, the base acute, the apex obtuse, mucronate or weakly cuspidate, 10–20(–24) mm. long, 3–4.5(–7) mm. wide, glabrous above, dull, strigillose beneath with whitish hairs, the veins often purplish on both surfaces, the leaflets somewhat conduplicate; petiolules 1–2 mm. long, densely strigillose with brown hairs. Inflorescences terminating main and axillary branches, erect, naked, short-peduncled, exceeding the leaves, (1–)2–9 cm. long, the flowering portion 0.5–2 cm. long with 3–5 crowded flowering nodes, the nodes buttressed; buds 3 at a node, 2 of these developing, flowering and fruiting, the third rudimentary. Primary bracts 2 cm. or less long, large, broadly ovate, acuminate, spathaceous, ca. 18-veined, reddish, deciduous before anthesis; secondary bracts absent. Pedicels 6–12 mm. long, ascending, strigillose. Dried flowers 20–22 mm. long. Calyx 5–6 mm. long, strigillose with fine rusty hairs, the upper lobes subulate, almost completely fused together, 1.5–2 mm. long, the lateral lobes deltoid-subulate, 3–3.5 mm. long, the lowermost linear-subulate, 4–5.5 mm. long. Corolla rose, the back of the banner orange, densely covered with fine rusty hairs; blade of the banner nearly orbicular, 16–18 mm. broad, tapering into a claw ca. 3 mm. long; wings ca. 22 mm. long, 8 mm. wide, exauriculate, the claw 3 mm. long; keel shallow, slightly beaked, 17–20 mm. long, the claw 3 mm. long. Staminal tube ca. 17 mm. long, the vexillary stamen coherent with the tube, broadened and thickened near the free base. Ovary rusty-hirtellous along both sutures, otherwise glabrous, the style barbate. Legumes straight, short-beaked, obliquely acute at either end, 4.5–5.5 cm. long, 8–9 mm. wide, horizontal or ascending, hirtellous along both sutures, the valves glabrous; seeds 9–16, ovoid, slightly compressed, 3.6–3.8 mm. long, 2.2–2.4 mm. wide, brown or black, the hilum near one end so that the long axis of the seed crosses the pod. Somatic chromosomes 22. Flowering collections throughout the year.

DISTRIBUTION. Native of South Africa; naturalized in Jamaica.

SPECIMENS EXAMINED. JAMAICA. Without locality, *Hart 524* (US); Blue Mts., St. Andrew near Cinchona, *Perkins 1017* (GH); rocky banks, vicinity of Cinchona, *Britton 210* (NY); dry slopes, Cinchona, *Shreve*, 1903 (NY); vicinity of Cinchona, trail to St. Helen's Gap, *A. Taylor 4237* (NY); Cinchona, 5000 ft., *Clute 188* (NY, PH, US); vicinity of Cinchona, 1550 m., *Killip 163* (US); partially shaded rocky bank, Cinchona, 1500 m., *Maxon 2598* (US); leeward slopes, Cinchona, Blue Mts., *Harris & Lawrence C1597* (NY, US); open brushy slope, vicinity of St. Helen's Gap, St. Andrew, 1475 m., *Maxon & Killip 565* (GH, US); edge of thicket by trail

near St. Helen's Gap, Blue Mt. range, 4780 ft., *Chrysler 1873* (PENN); open slopes, Flamstead and vicinity, Fort Royal Mts., 1000–1100 m., *Maxon 8656* (US); dry hillside, Whitefield Hall, St. Thomas Parish, Surrey, *Hunnewell & Griscom 14323* (GH); Whitefield Hall, *G. Collins 77* (US); Abbey Green, *Orcutt 3235* (UC, US).

Tephrosia grandiflora is easily recognizable by the large, rose-colored flowers, the ovate, acuminate stipules and the spathe-like, reddish or brownish primary bracts. The large, promptly deciduous bracts and broad stipules were largely the basis of the segregate genus *Apodynomene* E. Mey. of which this is the type-species. Although stipules and bracts of this kind characterize a group of South African species, and the absence of secondary bracts is indeed anomalous, there seem to be no real reasons for separating this group as a distinct genus. The sectional rank accorded it by Harvey (1861, p. 203), who contrasted it with *Eutephrosia* with narrow bracts and stipules, may possibly prove to be a more reasonable disposition.

47. **Tephrosia candida** DC.

Robinia candida Roxb. Cat. Hort. Calc. 56. 1814, nomen; DC. Prodr. **2:** 249. 1825, as synonym.

Tephrosia candida DC. Prodr. **2:** 249. 1825. Seen by DC. in Herb. Wallich, the specimen from Calcutta Gardens.

Robinia candida Roxb. Fl. Ind. **3:** 327. 1832. ". . . first reared in the Company's Botanic garden, from seed collected in the north of Bengal by Dr. Carey."

Xiphocarpus candidus (DC.) Endl. Gen. 1273. 1840; Zoll. & Mor. Nat. en Geneesk. Arch. Néerl. Indie. **3:** 76. 1846.

Kiesera candida Reinw. Syll. Pl. Nov. **2:** 11. 1828.

Kiesera sericea Reinw. ex Blume, Cat. Gew. Buitenz. 93. 1823, nomen; Reinw. Syll. Pl. Nov. **2:** 11. 1828.

Robinia sericea Sieber, Fl. Mart. Exsicc. no. 181; C. Presl, Symb. Bot. **1:** 14. 1832, as synonym.

Xiphocarpus martinicensis C. Presl, Symb. Bot. **1:** 14. pl. 7. 1832. Martinique, *Kohaut.* (Undoubtedly an introduced specimen.)

Shrub 1–3 m. high; branches angled, striate or sulcate. Branches, petioles, rachises, petiolules and axes of inflorescences strigillose to short-strigose or hirtellous to hirsutulous with golden or tawny hairs. Principal leaves 5–22 cm. long, the petioles 6–20 mm. long, the rachis 3.5–14 cm. long; stipules linear-subulate, ca. 5–10 mm. long, persistent; leaflets of the principal leaves (13–)17–27, lance-oblong to linear-oblong or oblong, the base acute, the apex acute and cuspidate, 1.5–7 cm. long, 6–13 mm. wide, firm, green, glabrous or with a few scattered minute hairs ca. 0.2 mm. long above, pale beneath, moderately strigillose to strigose or hirtellous to

hirsutulous with soft cinereous to golden hairs, silky or lustrous; petiolules 2–3 mm. long, slender, conspicuous. Inflorescences usually short, dense, terminal and in the upper axils, the terminal flower-bearing portion 2–19 cm. long, 1 or 2 nodes often with leaves, the axillary inflorescences often reduced to dense clusters in the axils, the flowering nodes 5–35; buds ca. 5–10 at a node, 3–6 flowering, 1 or 2 fruiting. Primary bracts subulate, 4–7 mm. long, caducous; secondary bracts ca. 3 mm. long, caducous. Pedicels 8–15 mm. long, strigillose to hirtellous. Dried flowers 23–26 mm. long. Calyx 4–5 mm. long, strigillose to hirtellous with rusty hairs, the tube ca. 4 mm. long, the upper lobes nearly obsolete, rounded, blunt, with a very broad, shallow sinus 0.5–1 mm. deep between them, the lateral lobes rounded-ovate, abruptly and minutely acuminate, 1.5–2 mm. long, the lowermost lobe ovate, 2–3 mm. long. Corolla white; blade of the banner broadly obovate, 20–22 mm. high and wide, finely short-strigose on the back, the broad claw 3–4 mm. long; wings 24–25 mm. long, 10–12 mm. wide, the claw 3 mm. long, exauriculate; keel 22–24 mm. long, 10–11 mm. deep, the claw 3.5–4 mm. long. Staminal tube 18–20 mm. long, the vexillary stamen coherent with the tube, free at the base, with a conspicuous callosity on the upper side near the base. Ovary densely strigillose, the style barbate. Legumes linear, 6–9 cm. long, 7–9 mm. wide, both strigillose and strigose or hirtellous and hirsutulous with rusty or tawny hairs, often silky but not appearing conspicuously hairy, brown; seeds 10–13, compressed, 3.2–3.6 mm. wide, brown to gray variegated with black, with a conspicuous white caruncle ca. 1 mm. high excentrically placed.

Distribution. Native of India; naturalized in Jamaica and apparently in Suriname, Venezuela and Colombia, possibly escaping from cultivation in Puerto Rico, Dominica, St. Kitts and Brazil.

Specimens examined. JAMAICA. Bush 3 m. high, Swift River, Hope, 160 m., *Harris 6031*, 1895 (NY); river banks, 480 ft., near Castleton, *Harris 9040*, 1905 (NY, US); gravelly river course, Castleton, 500 ft., *Harris 11804*, 1914 (CAS, F, GH, NY, US); hillside, Maryland, vicinity of Newcastle, *Britton 3292*, 1908 (NY); Golden Spring, 235 m., *Fawcett 7988*, 1900 (F, NY, US).

PUERTO RICO. Hacienda Carmelita, Ponce, 500 m., (introduced?), *Sargent 3118*, 1943 (US); planted south of Carolina, *Britton & Britton 9949*, 1932 (NY).

DOMINICA. Without locality, *Fairchild 2721*, 1932 (US).

ST. KITTS. Belmont Estate, *Britton & Cowell 411*, 1901 (NY, US).

HONDURAS. Cultivated, Lancetilla Valley, near Tela, Dept. Atlantida, 20–60 m., *Standley 53646*, 1927–28 (US).

COLOMBIA. Antioquia: Laguna de Guarne, *Bro. Daniel 2758*, 1942 (US). Valle del Cauca: North of Palmira (Cauca valley), 1050 m., *Garcia B. 6487*, Dec. 1938–Jan. 1939 (US).

VENEZUELA. Carabobo: Valencia, "grows wild but is cultivated," *Archer 311*, 1935 (US).

SURINAME. Scotelweg, *Archer 2665*, 1934 (F, US); Sandrij Island, "cultivated cover crop, but also said to be wild in bush," *Archer 2755*, 1934 (US).

BRAZIL. SAÕ PAULO: Fazenda Sta. Elisa, Campinas, *Houk & Santoro 534*, 1936 (US).

The large flowers, the almost completely fused upper lobes of the calyx, the narrow bracts and the large legumes and seeds are characteristic of this handsome species which appears to be spreading in tropical America. Two pubescence-forms, which seem to represent normal variations in wild Asiatic populations (as represented by herbarium-specimens), occur in the Americas. In one (e. g., all specimens from Jamaica and St. Kitts) the pubescence of the entire plant is appressed. In the second (e.g., specimens from Puerto Rico and Dominica), the stems, petioles and rachises are hirtellous and the leaves softly hirtellous to hirsutulous beneath. The hairs on the legumes of the former are appressed, those on the legumes of the latter spreading.

48. **Tephrosia Vogelii** Hook. f.

Tephrosia Vogelii Hook. f. Niger Fl. 296. 1849. "On the Quorra [Nigeria], and Fernando Po, *Vogel*."

Cracca Vogelii (Hook. f.) Kuntze, Rev. Gen. **1:** 175. 1891.

This species, a native of tropical Africa, is represented in America by an old specimen marked "West Indies—M. Perrin," (NY). This probably represents an early introduction of the species, but not necessarily an escape from cultivation. *Tephrosia Vogelii* has been grown as an ornamental shrub and as a cover-crop in tropical Africa and southeastern Asia and is a well-known fish-poisoning plant. It is being cultivated in tropical America and may escape from cultivation. The only other American specimen I have seen is from Honduras: Cultivated, Lancetilla Valley, near Tela, Dept. Atlantida, 20–60 m., *Standley 53459*, 1927–28 (US). The species is probably related to *T. candida*, but is easily recognized by the large, white flowers 35 mm. long, by the large calyx with oblong lateral lobes, by the pods 10–12 cm. long, 13 mm. wide and densely hirsute with soft, tawny hairs, and by the compressed black seeds about 6–7 mm. long and 4–4.5 mm. wide with a prominent white caruncle.

49. **Tephrosia bracteolata** Guill. & Perr.

Tephrosia bracteolata Guill. & Perr. Fl. Seneg. Tent. 194. 1830. Lam Sar, near St. Louis, Senegambia.

Cracca bracteolata (Guill. & Perr.) Kuntze, Rev. Gen. **1:** 174. 1891.

Tephrosia bracteolata is known in our area from a single specimen from the herbarium of R. T. Lowe, and now in the Gray Herbarium. It was collected in "Santo Domingos", 29 January 1866. In the absence of other information this species should be regarded as a stray introduction and not as an established member of the American flora. The plant is easily distinguished from other species known from the Americas by its 11–15 linear leaflets which are 2–6 cm. long, 2–4 mm. wide, obtuse to retuse at the apex, glabrous above and densely strigillose beneath, by the slender, few-flowered racemes inserted obliquely in the axils, by the small flowers 10–12 mm. long, by the strigillose calyx 2 mm. long, and by the hirtellous legume 4.5 cm. long and 4 mm. wide. A more complete description is to be found in Rydberg, N. Amer. Fl. **24:** 182. 1923. I have seen no authentic material of this species and am not convinced that this identification is correct.

Excluded Glabrous-styled Tephrosias

The following list is composed of names which have been applied to American glabrous-styled species of *Tephrosia.* The synonymy given is primarily nomenclatural with but a few taxonomic references in connection with species with which I am familiar.

Tephrosia adscendens Benth. in Mart. Fl. Bras. **15**(1): 48. 1859.

Tephrosia adunca Benth. Ann. Nat. Hist. I. **3**: 432. 1839. *Cracca adunca* (Benth.) Kuntze, Rev. Gen. **1**: 174. 1891. *Tephrosia adunca* var. *genuina* Hassl. in Fedde, Rep. Spec. Nov. **16**: 165. 1919.

Tephrosia adunca var. acutifolia Chod. & Hassl. Bull. Herb. Boiss. II. **4**: 839. 1904.

Tephrosia adunca var. genuina f. pseudo-marginata Hassl. in Fedde, Rep. Spec. Nov. **16**: 165. 1919.

Tephrosia adunca var. guaranitica (Chod. & Hassl.) Hassl. in Fedde, Rep. Spec. Nov. **16**: 165. 1919. *Tephrosia guaranitica* Chod. & Hassl.

Tephrosia adunca var. intermedia Chod. & Hassl. Bull. Herb. Boiss. II. **4**: 839. 1904.

Tephrosia adunca var. intermedia f. glabrior Chod. & Hassl. Bull. Herb. Boiss. II. **4**: 1904.

Tephrosia adunca var. rufescens (Benth.) Hassl. in Fedde, Rep. Spec. Nov. **16**: 165. 1919. *Tephrosia rufescens* Benth.

Tephrosia adunca var. rufescens f. grandifolia Hassl. in Fedde, Rep. Spec. Nov. **16**: 165. 1919.

Tephrosia adunca var. rufescens f. paraguayensis (Ulbr.) Hassl. in Fedde, Rep. Spec. Nov. **16**: 165. 1919. *Tephrosia rufescens* var. *paraguayensis* Ulbr.

Tephrosia adunca var. subglabrata Hassl. in Fedde, Rep. Spec. Nov. **16**: 165. 1919.

Tephrosia ascendens Macfadyen, Fl. Jamaica **1**: 257. 1837. = *T. purpurea* (L.) Pers.?

Tephrosia angustissima Shuttlew. ex. Chapm. Fl. Southern U. S. 96. 1865, not Engl. Bot. Jahrb. **10**: 29. 1888. *Cracca angustissima* (Shuttlew. ex Chapm.) Kuntze, Rev. Gen. **1**: 174. 1891 *Tephrosia purpurea* var. *angustissima* (Shuttlew. ex Chapm.) B. L. Robinson.

Cracca benensis Rusby, Mem. N. Y. Bot. Gard. **7**: 262. 1927.
Tephrosia Brandegei (Standl.) Riley, Kew Bull. **1923**: 339. 1923. *Cracca Brandegei* Standl. Contr. U. S. Nat. Herb. **20**: 217. 1919.
Tephrosia brevipes Benth. Ann. Nat. Hist. I. **3**: 432. 1839. *Cracca brevipes* (Benth.) Kuntze, Rev. Gen. **1**: 174. 1891. = *Tephrosia sessiliflora* (Poir.) Hassl.
Tephrosia cathartica (Sessé & Moc.) Urb. Symb. Ant. **4**: 283. 1905. *Galega cathartica* Sessé & Moc. Fl. Mex. ed. 2. 175. 1894. *Cracca cathartica* (Sessé & Moc.) Britt. & Millsp. Bahama Fl. 181. 1920. = *Tephrosia Senna* HBK.
Tephrosia cinerea (L.) Pers. Syn. Pl. **2**: 328. 1807 *Galega cinerea* L. Syst. Nat. ed. 10. **2**: 1172. 1759. *Cracca cinerea* (L.) Morong, Ann. N. Y. Acad. Sci. **7**: 79. 1892. *Colinil cinereum* (L.) Hitchc. Mo. Bot. Gard. Rep. **4**: 75. 1893. *Tephrosia cinerea* var. *typica* Hassl. in Fedde, Rep. Spec. Nov. **16**: 166. 1919.
Tephrosia cinerea β littoralis (Jacq.) Benth. in Mart. Fl. Bras. **15**(1): 48. July 1859. *Tephrosia cinerea β littoralis* (Jacq.) Griseb. Fl. Br. W. Ind. 182. 1859 (probably latter half of year). = *T. cinerea* (L.) Pers.
Tephrosia cinerea var. typica f. pseudo-adunca Hassl. in Fedde, Rep. Spec. Nov. **16**: 166. 1919.
Tephrosia cinerea γ villosior Benth. in Mart. Fl. Bras. **15**(1): 48. 1859. = *T. cinerea* (L.) Pers.
Cracca corallicola Small, Bull. Torrey Club **36**: 160. 1909.
Cracca Curtissii Small ex Rydb. N. Amer. Fl. **24**: 179. 1923.
Tephrosia decumbens Benth. ex Benth. & Oerst. Kjoeb. Vidensk. Meddel. **1853**: 7. 1854. *Cracca decumbens* (Benth. ex Benth. & Oerst.) Kuntze, Rev. Gen. **1**: 175. 1891.
Tephrosia domingensis (Willd.) Pers. Syn. Pl. **2**: 330. 1807. *Galega domingensis* Willd. Sp. Pl. **3** (2): 1249. 1802. *Cracca domingensis* (Willd.) Rydb. N. Amer. Fl. **24**: 181. 1923. = *Tephrosia cinerea* (L.) Pers., at least sensu Rydb.
Tephrosia egregia Sandwith, Kew Bull. **1927**: 249. 1927.
Tephrosia guaranitica Chod. & Hassl. Bull. Herb. Boiss II. **4**: 879. 1904. *Tephrosia adunca* var. *guaranitica* (Chod. & Hassl.) Hassl.
Tephrosia gynothrix Miq. Linnaea **18**: 29. 1844. = *Tephrosia cinerea* (L.) Pers.
Tephrosia hassleri Chod. Bull. Herb. Boiss. II. **4**: 879. 1904; emend Hassl. in Fedde, Rep. Spec. Nov. **16**: 163. 1919.
Cracca hirta (Buch.-Ham.) Britton & Wilson, Sci. Surv. Porto Rico & Virgin Ids. **6**: 351. 1926. *Galega hirta* Buch.-Ham. Trans. Linn. Soc. **13**: 546. 1822. *Cracca hirta* sensu Britton & Wilson appears to be *Tephrosia noctiflora* Boj. ex Baker, but the plant described by Hamilton from India cannot be that species and from the description seems to be *Tephrosia villosa* (L.) Pers., a plant with very different calyx-lobes.
Cracca hypoleuca Rydb. N. Amer. Fl. **24**: 180. 1923, not *C. hypoleuca* (Boiss.) Alef. 1861, nor *Tephrosia hypoleuca* Riley, 1923. *Indigofera Perriniana* Spreng. Neue Entd. **2**: 161. 1821, not *Galega Perriniana* Spreng. l. c., nor *Cracca Perriniana* (Spreng.) Kuntze, Rev. Gen. **1**: 175. 1891, nor *Tephrosia Perriniana* (Spreng.) DC. Prodr. **2**: 261. 1825. Known from the New World only by a single collection sent to Sprengel by Perrin, presumably from the West Indies (NY). This seems to be the plant treated by Baker in Oliver, Fl. Trop. Afr. **2**: 120. 1871, as *Tephrosia linearis* (Willd.) Pers. and matches specimens cited by Baker. It should be regarded as nothing more than a waif in the Western Hemisphere.
Tephrosia leptostachya DC. Prodr. **2**: 251. 1825. *Cracca leptostachya* (DC.) Rusby, Mem. Torr. Club **3**(3): 18. 1893. The description of this species from Senegal could apply to any of several dozen species, and the name has been used for a number of plants both endemic and introduced in the Americas. I have not been able to determine the correct application of this name.

TEPHROSIA LEPTOSTACHYA β LEPTOPHYLLA Benth. in Mart. Fl. Bras. **15**(1): 49. 1859.

TEPHROSIA LINEARIS (Willd.) Pers. Syn. Pl. **2**: 330. 1807. *Galega linearis* Willd. Sp. Pl. **3**(2): 1248. 1802. See *Cracca hypoleuca* Rydb.

TEPHROSIA LITTORALIS (Jacq.) Pers. Syn. Pl. **2**: 329. 1807. *Vicia littoralis* Jacq. Enum. Pl. Carib. 27. 1760. *Galega littoralis* (Jacq.) L. Syst. Nat. ed. 12. **2**: 497. 1767. *Cracca littoralis* (Jacq.) Rydb. N. Amer. Fl. **24**: 178. 1923. *Tephrosia cinerea β littoralis* (Jacq.) Benth. *Tephrosia cinerea β littoralis* (Jacq.) Griseb. = *Tephrosia cinerea* (L.) Pers.

TEPHROSIA MARGINATA Hassl. in Fedde, Rep. Spec. Nov. **16**: 162. 1919.

TEPHROSIA MARGINATA var. CINERASCENS Hassl. in Fedde, Rep. Spec. Nov. **16**: 163. 1919.

TEPHROSIA MARGINATA var. PSEUDO-RUFESCENS Hassl. in Fedde, Rep. Spec. Nov. **16**: 163. 1919.

TEPHROSIA NERVOSA Chod. & Hassl. Bull. Herb. Boiss. II. **4**: 839. 1904.

TEPHROSIA NOCTIFLORA Boj. ex Baker in Oliver, Fl. Trop. Afr. **2**: 112. 1871. *Cracca noctiflora* (Boj. ex Baker) Kuntze, Rev. Gen. **1**: 175. 1891. *Cracca hirta* (Buch.-Ham.) Britton & Wilson, Sci. Surv. Porto Rico & Virgin Ids. **6**: 351. 1926, as to plant, not basonym (*Galega hirta* Buch.-Ham. = *Tephrosia villosa* (L.) Pers.?). Naturalized in the West Indies from Africa.

TEPHROSIA PENICILLATA Benth. Ann. Nat. Hist. I. **3**: 431. 1839. = *Tephrosia adunca* Benth. according to Benth. in Mart. Fl. Bras. **15**(1): 47. 1859.

TEPHROSIA PISCATORIA (Ait.) Pers. Syn. Pl. **2**: 329. 1807. *Galega piscatoria* Ait. Hort. Kew. ed. 1. **3**: 71. 1789. *Cracca piscatoria* (Ait.) Lyons, Pl. Names Scientific & Popular 120. 1900, basonym attributed to Solander. The habitat was said in the original description to be "India orientali et ins. Maris pacifici." This name has been applied to native American plants which bear little resemblance to the species described.

TEPHROSIA PERRINIANA (Spreng.) DC. Prodr. **2**: 251. 1825. *Galega Perriniana* Spreng. Neue Entdeck. **2**: 161. 1821. *Cracca Perriniana* (Spreng.) Kuntze, Rev. Gen. **1**: 175. 1891. Not *Indigofera Perriniana* Spreng. nor *Cracca hypoleuca* Rydb. Said by Sprengel to be related to *Galega domingensis* Willd., but the description completely inconclusive. This may not be a *Tephrosia* at all. Probably from South America.

TEPHROSIA PROCUMBENS Macfadyen, Fl. Jamaica **1**: 256. 1837. = *T. cinerea* (L.) Pers.

TEPHROSIA PURPUREA (L.) Pers. Syn. Pl. **2**: 329. 1807. *Cracca purpurea* L. Sp. Pl. ed. 1. **2**: 752. 1753. *Galega purpurea* L. Syst. Nat. ed. 10. **2**: 1172. 1759. Introduced from India and naturalized on beaches and sandy disturbed soils in Jamaica, Hispaniola, Dominica, Martinique, Barbados and Trinidad. The plant described by Linnaeus appears to be this species with 11–19 relatively large yellowish-green, cuneate-oblong, cuneate or obovate leaflets, rather coarse, often erect habit, staminal tube 5–5.5 mm. long, and legumes with 5–7 seeds, characters which distinguish it from *Tephrosia cinerea* and *T. Senna* with which it is often confused. (See GH-photograph of Type, *Galega*, Sheet no. 7, in Herb. L.) This plant appears to be the same as that described as *T. Wallichii* Graham ex Fawcett & Rendle. Although *T. purpurea* is assigned a pan-tropical distribution by many authors, a number of species are involved.

TEPHROSIA PURPUREA var. ANGUSTISSIMA (Shuttlew. ex Chapm.) B. L. Robinson, Bot. Gaz. **28**: 201. 1899. *T. angustissima* Shuttlew. ex Chapm.

TEPHROSIA RUFESCENS Benth. Linnaea **22**: 513. 1849. *T. adunca* var. *rufescens* (Benth.) Hassl.

TEPHROSIA RUFESCENS var. PARAGUAYENSIS Ulbr. in Fedde, Rep. Spec. Nov. **2**: 12. 1906. *T. adunca* var. *rufescens* f. *paraguayensis* (Ulbr.) Hassl.

CRACCA RUSBYI Rydb. N. Amer. Fl. **24**: 181. 1923.

CRACCA SCHOTTII Vail, Bull. Torr. Cl. **22**: 25. 1895. = *Tephrosia Senna* HBK.

Tephrosia scopulorum Brandeg. Univ. Calif. Publ. Bot. **6**: 181. 1915. = *T. cinerea* (L.) Pers.

Tephrosia Senna HBK. Nov. Gen. et Sp. (folio) **6**: 359. Aug. 1824. Op. cit. (quarto) **6**: 458. Sept. 1824. *Cracca Senna* (HBK.) Kuntze, Rev. Gen. **1**: 175. 1891. Collected by Humboldt and Bonpland on the Cauca River near Buga, Valle del Cauca, Colombia, Oct. 1801. The detailed description clearly applies to the plant which has been known as *Tephrosia cathartica* (Sessé & Moc.) Urb., and Mr. E. P. Killip writes me that he has examined the Type at Paris and that it is indeed this species.

Tephrosia sessiliflora (Poir.) Hassl. in Fedde, Rep. Spec. Nov. **16**: 162. 1919. *Cytisus sessiliflorus* Poir. in Lam. Encycl. Suppl. **2**: 439. 1811. *Rhynchosia sessiliflora* (Poir.) DC. Prodr. **2**: 389. 1825. *Tephrosia brevipes* Benth. This species is quite unlike any other American member of the genus. The circumscissile calyx, entirely axillary flowers, 1–3 leaflets and glabrous styles set it apart from all other species in our region. It is known from Oaxaca, Mexico, (Guatulco, *Liebmann 5165*, Oct. 1843, F-fragment ex Herb. Bot. Mus. Copenhagen), Haiti, Trinidad, Venezuela, British Guiana, Brazil and Paraguay.

Tephrosia tenella A. Gray, Pl. Wright. **2**: 36. 1853. *Cracca tenella* (A. Gray) Rose, Contr. U. S. Nat. Herb. **12**: 271. 1909.

Tephrosia venustula HBK. Nov. Gen. et Sp. (folio) **6**: 360. Aug. 1824; Op. cit. (quarto) **6**: 459. Sept. 1824. According to Bentham in Mart. Fl. Bras. **15**(1): 47. 1859, this is *Tephrosia cinerea* (L.) Pers.

Tephrosia vicioides Schlecht. Linnaea **12**: 297. 1838, not A. Rich. 1847. *Cracca vicioides* (Schlecht.) Kuntze, Rev. Gen. **1**: 175. 1891.

Tephrosia villosa (L.) Pers. Syn. Pl. **2**: 329. 1807. *Galega villosa* L. Syst. Nat. ed. 10. **2**: 1172. 1759. *Cracca villosa* L. Sp. Pl. ed. 1. **2**: 752. 1753. Known to me only from cultivated specimens in the Americas.

Cracca villosa δ cinerea (L.) Kuntze, Rev. Gen. **1**: 173. 1891. = *Tephrosia cinerea* (L.) Pers.

Tephrosia Wallichii Graham ex Fawcett & Rendle, Jour. Bot. **55**: 35. 1917. *Cracca Wallichii* (Graham ex Fawcett & Rendle) Rydb. N. Amer. Fl. **24**: 180. 1923. = *Tephrosia purpurea* (L.) Pers., introduced into the West Indies.

Species Excluded from Tephrosia

Tephrosia amorphaefolia Kunth & Bouché, Ann. Sci. Nat. III. **7**: 189. 1847. Unknown to me.

Tephrosia aniloides Bello, Anal. Soc. Esp. Hist. Nat. **10**: 258. 1881. *Cracca aniloides* (Bello) Cook & Collins. = *Cracca caribaea* (Jacq.) Benth.

Tephrosia astragalina HBK. Nov. Gen. et Sp. (quarto) **6**: 464. Sept. 1824; Op. cit. (folio) **6**: 363. Sept. 1824. *Cracca astragalina* (HBK.) Kuntze, Rev. Gen. **1**: 174. 1891. Not *Tephrosia*.

Tephrosia Barclayi Baillon, Bull. Soc. Linn. Paris **1**: 388. 1883. According to Rydberg, N. Amer. Fl. **24**: 183. 1923, this is a species of *Dalbergia*.

Cracca bicolor Micheli, Bull. Herb. Boiss. **2**: 444. pl. 11. 1894. = *Cracca* Benth.

Crafordia bracteata Raf. Specchio **1**: 156. 1814. Although this name is usually assigned to the synonymy of *Tephrosia spicata* (Walt.) T. & G., the plant described by Rafinesque from the Susquehannah River, Pennsylvania, United States, cannot possibly be a *Tephrosia;* the description certainly does not apply to any species of the genus in the United States.

Tephrosia caribaea (Jacq.) DC. Prodr. **2**: 251. 1825. *Galega caribaea* Jacq. Sel. Stirp. Am. 212. 1763. *Cracca caribaea* (Jacq.) Benth. ex Benth. & Oerst. Kjoeb. Vidensk. Meddel. **1853**: 9. 1854. = *Cracca* Benth.

Cracca caribaea var. Edwardsii (Gray) Hassl. in Fedde, Rep. Spec. Nov. **16**: 160. 1919. = *Cracca* Benth.

Cracca caribaea var. glandulifera Hassl. in Fedde, Rep. Spec. Nov. **16**: 160. 1919. = *Cracca* Benth.

CRACCA CARIBAEA var. GLANDULIFERA f. DUBIA Hassl. in Fedde, Rep. Spec. Nov. **16**: 160. 1919. = *Cracca* Benth.

TEPHROSIA CHILENSIS Trev. Linnaea **10**: Litt. 73. 1836. Grown from seeds supposedly from Chile. No Tephrosias are known to me from that region and the plant with 2-seeded pods described does not seem to be one.

TEPHROSIA COERULEA Pers. Syn. Pl. **2**: 329. 1807. = *Dalea Mutisii* Kunth, according to Index Kewensis.

CRACCA COLLINA M. E. Jones, Contr. West. Bot. **15**: 137. 1929. = *Eriosema grandiflorum* (Schlecht. & Cham.) Seem. Bot. Voy. Herald 345. 1857. See Standley, Field Mus. Publ. Bot. **11**: 161. 1936.

TEPHROSIA CONSTRICTA S. Wats. Proc. Amer. Acad. **24**: 46. 1889. *Cracca constricta* (S. Wats.) Tidestrom, Proc. Biol. Soc. Wash. **48**: 40. 1935. = *Sphinctospermum constrictum* (S. Wats.) Rose, Contr. U. S. Nat. Herb. **10**: 107. pl. 34. 1906, a monotypic genus separated morphologically and cytologically from *Tephrosia* and more closely allied to *Cracca* Benth.

CRACCA CORUMBAE Hoehne, Comm. Linh. Telegr. Estrat. Matto-Grosso (Publ. 45), Annexo 5, Bot. pt. 8: 63 (as Gracca), pl. 153. 1919. Unknown to me, but not *Tephrosia*.

TEPHROSIA CRACCOIDES Lillo, Bol. Mus. Cien. Nat. Univ. Tucuman, no. 6: 8. 1925, without Latin diagnosis and described merely as "Planta de tres a quatro metros de alto, de flor blanca." This is *Coursetia brachyrhachis* Harms (see Burkart 1943, p. 297).

BALBOA DIVERSIFOLIA Liebm. Kjoeb. Vidensk. Meddel. **1853**: 106. 1854. "Habitat ad oram occidentalem Mexici (Dep. Oajaca) inter Chacalapa et S. Jago Estata," *Liebmann 4626*, Nov. 1842 (US). Although usually referred to the synonymy of *Tephrosia*, Liebmann clearly indicated this to be a member of the Tribe Phaseolae and probably most closely related to *Periandra* Mart. I have been unable to place this plant, but it certainly is not a *Tephrosia*.

TEPHROSIA DOLICHOCARPA Griseb. Goett. Abh. **24**: 101. 1879. *Cracca dolichocarpa* (Griseb.) Kuntze, Rev. Gen. **1**: 175. 1891. Apparently known only from the Sierra de Cordoba in Argentina, this species is not a *Tephrosia*. I have not seen flowering specimens, but the inflorescence appears to be different from that of *Tephrosia* and the leaflets are stipellate, a feature unknown in *Tephrosia*.

CRACCA EDWARDSII A. Gray, Pl. Wright. **2**: 36. 1853. *Cracca caribaea* var. *Edwardsii* (A. Gray) Hassl. = *Cracca* Benth.

CRACCA EDWARDSII var. GLABELLA A. Gray, Proc. Amer. Acad. **17**: 201. 1882. = *Cracca* Benth.

CRACCA EDWARDSII var. SERICEA A. Gray, Proc. Amer. Acad. **17**: 201. 1882. *Cracca sericea* A. Gray. = *Cracca* Benth.

TEPHROSIA? ELLIOTTII (Nutt.) Benth. Ann. Wien. Mus. **2**: 127, in obs. 1838. = *Galactia Elliottii* Nutt.

TEPHROSIA FILIFORMIS (Jacq.) Pers. Syn. Pl. **2**: 328. 1807. *Galega filiformis* Jacq. Collect. **2**: 348. 1788. *Cracca filiformis* (Jacq.) Kuntze, Rev. Gen. **1**: 175. 1891. The plant illustrated by Jacquin is a species of *Galactia*.

TEPHROSIA FRUTICOSA M. E. Jones, Extr. Contr. West. Bot. **18**: 43. 1933. The "flowers yellow and purple-veined," cannot apply to *Tephrosia*. Jones noted, "This may be an Eriosema." This plant was collected in the Barranca of Guadalajara where a shrubby *Eriosema* is a conspicuous element. See also Morton, Contr. U. S. Nat. Herb. **29**: 104. 1945.

TEPHROSIA FRUTESCENS (Mill.) DC. Prodr. **2**: 256. 1825. *Galega frutescens* Mill. Gard. Dict. ed. 8. *Galega* no. 3. 1768. *Cracca frutescens* (Mill.) Kuntze, Rev. Gen. **1**: 175. 1891. According to Britten and Baker, Jour. Bot. **35**: 225. 1897, this is *Indigofera mucronata* Spreng. ex DC.

TEPHROSIA GLABRESCENS Benth. Bot. Voy. Sulph. 81. 1844. *Cracca glabrescens* Benth. ex Benth. & Oerst. Kjoeb. Vidensk. Meddel. **1853**: 9. 1854. = *Cracca* Benth.

Tephrosia glandulifera Benth. Bot. Voy. Sulph. 81. 1844. *Cracca glandulifera* Benth. ex Benth. & Oerst. Kjoeb. Vidensk. Meddel. **1853:** 8. 1854. = *Cracca* Benth. or *Coursetia glandulifera* (Benth.) Macbr.

Cracca Greenmannii Millsp. Field Col. Mus. Bot. Ser. **1:** 299. pl. 13. 1896. = *Cracca* Benth.

Tephrosia heterantha Griseb. Goett. Abh. **24:** 101. 1879. *Cracca heterantha* (Griseb.) Kuntze, Rev. Gen. **1:** 175. 1891. *Cracca Kuntzei* Harms ex Kuntze. *Neocracca heterantha* (Griseb.) Spegazzini, Physis **8:** 119. 1925. A peculiar plant, apparently an aberrant member of or closely related to *Cracca* Benth. (see Burkart 1943).

Cracca Kuntzei Harms ex Kuntze, Rev. Gen. **3**(2)**:** 69. 1898. *Neocracca Kuntzei* (Harms ex Kuntze) Kuntze, l. c. = *Cracca heterantha* (Griseb.) Kuntze or *Neocracca heterantha* (Griseb.) Spegazzini.

Tephrosia longifolia (Jacq.) Pers. Syn. Pl. **2:** 328. 1807. *Galega longifolia* Jacq. Collect. **2:** 349. 1788. The plant illustrated by Jacquin is a species of *Galactia.*

Cracca micrantha Micheli in Dur. & Pitt. Bull. Soc. Bot. Belg. **30**(1)**:** 286. 1891. *Benthamantha mollis* var. *micrantha* (Micheli) Standl. = *Cracca* Benth.

Cracca mollis (HBK.) Benth. & Oerst. Kjoeb. Vidensk. Meddel. **1853:** 9. 1854. *Tephrosia mollis* HBK. Nov. Gen. et Sp. (folio) **6:** 363. Sept. 1824; Op. cit. (quarto) **6:** 463. Sept. 1824, not *T. mollis* Valet. 1907. = *Cracca mollis* (HBK.) Benth. & Oerst. or *Coursetia mollis* (HBK.) Macbr.

Tephrosia moschata Tussac, Fl. Antill. **2:** 22. pl. 6. 1818. = *Corynella dubia* (Poir.) Urb.

Tephrosia? ochroleuca (Jacq.) Pers. Syn. Pl. **2:** 329. 1807. *Galega ochroleuca* Jacq. Collect. **1:** 79. 1786. *Cracca ochroleuca* (Jacq.) Benth. & Oerst. Kjoeb. Vidensk. Meddel. **1853:** 9. 1854. = *Cracca* Benth. or *Coursetia ochroleuca* (Jacq.) Macbr.

Tephrosia oroboides HBK. Nov. Gen. et Sp. (folio) **6:** 362. (not pl. 578.) Sept. 1824; Op. cit. (quarto) **6:** 462. (not pl. 578.) Sept. 1824. *Cracca oroboides* (HBK.) Kuntze, Rev. Gen. **1:** 175. 1891, as *orobodes.* = *Lotus oroboides* (HBK.) Ottley ex Kearney & Peebles, Jour. Wash. Acad. Sci. **29:** 483. 1939. (F-fragment of Type). (See Ottley, Brittonia **5:** 101. 1944.)

Galega polygama Sessé & Moc. Fl. Mexic. ed. 2. 174. 1894. Although described with **Galega cathartica* Sessé & Moc. and **G. cinerea*, this apparently is not *Tephrosia.* Described as having "folia ternata, foliolis ellipticis."

Cracca pumila (Rose) M. E. Jones, Extr. Contr. West. Bot. **18:** 44. 1933. = *Cracca* Benth.

Cracca sericea A. Gray, Proc. Amer. Acad. **19:** 74. 1893. = *Cracca* Benth.

Tephrosia stipularis (Desv.) DC. Prodr. **2:** 254. 1825. *Brissonia stipularis* Desv. Jour. Bot. **1:** 74. 1814. *Cracca stipularis* (Desv.) Kuntze, Rev. Gen. **1:** 175. 1891. Apparently not a species of *Tephrosia.*

Tephrosia velutina Spreng. Syst. **3:** 232. 1826. *Cracca velutina* (Spreng.) Kuntze, Rev. Gen. **1:** 175. 1891, not Rydb. 1923. This cannot be a species of *Tephrosia.* It was described as "Foliis ternatis . . . fruticosa volubilis, foliolis oblongis, . . ," etc.

Tephrosia venosa Mart. & Gal. Bull. Acad. Brux. **10**(2)**:** 47. 1843. *Cracca venosa* (Mart. & Gal.) Kuntze, Rev. Gen. **1:** 175. 1891. This apparently is a species of *Cracca* Benth. The authors noted its relationship to *Tephrosia mollis* HBK. (= *Cracca mollis* (HBK.) Benth.)

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Additions and Corrections

Page 233, 234: Note that the synonymy given for *Tephrosia* Pers. includes only names which have been applied to species indigenous to or introduced into the Americas.

Page 267: To the synonymy of *Tephrosia virginiana* add *Tephrosia virginiana* var. *leucosericea* (Rydb.) F. J. Hermann, Jour. Wash. Acad. Sci. **38**: 237. 1948.

Page 315: To the synonymy of *Tephrosia chrysophylla* × *T. florida* add *Tephrosia ambigua* (M. A. Curtis) Chapm. var. *intermedia* (Small) F. J. Hermann, Jour. Wash. Acad. Sci. **38**: 237. 1948.

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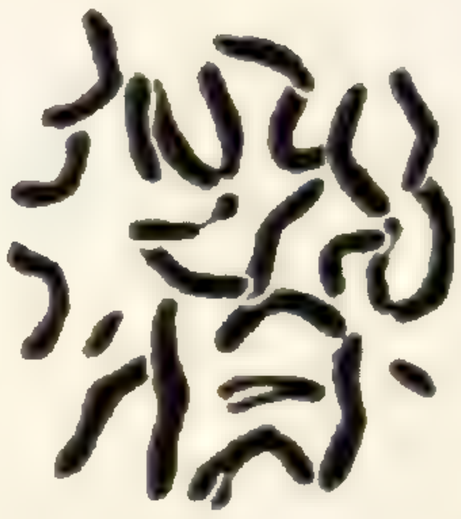
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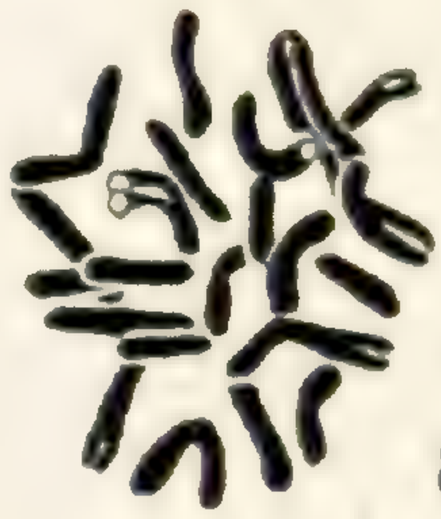
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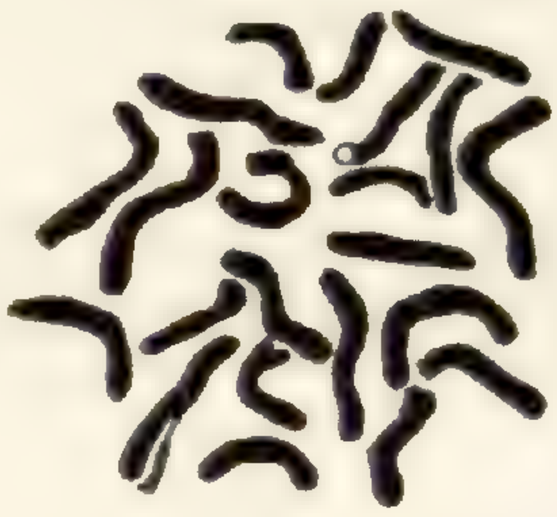
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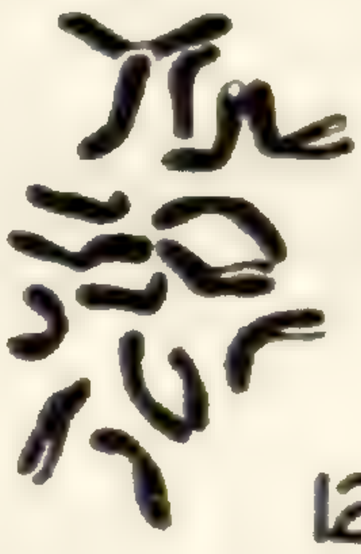
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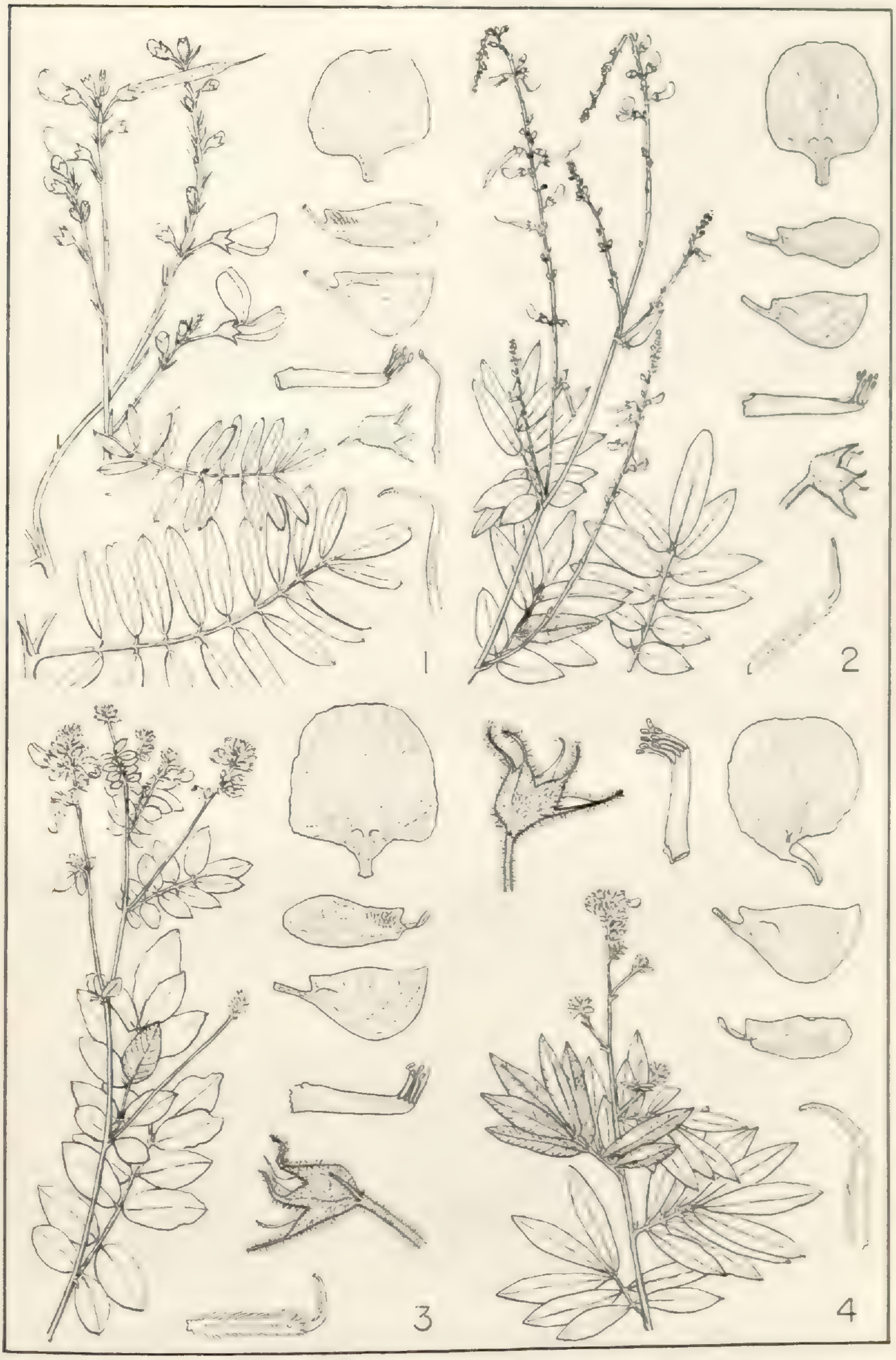
EXPLAINED IN FOOTNOTE, P. 204



C. E. W. del.

New Barbistyled Species of Tephrosia. 1. T. saxicola (habit, isotype-UC; details, Type-GH). 2. T. mexicana (Type-GH). 3. T. pogonocalyx (Type-GH). 4. T. vernicosa (habit, isotype-GH; details, Type-NY). All details, × 1: habit, Fig. 1, × 1/2: habit, Figs. 2, 3, 4, × 1/4.

C. E. W. del.

TEPHROSIA QUERCETORUM, sp. nov. Habit, × ½; details, × 1. (Central flowering plant from *Hernandez & Alexander XA159*-GH; remaining figures from type-collection-GH.)

C. E. W. del.

TEPHROSIA ABBOTTIAE, sp. nov. Habit, × ½; details, × 1. Interior surface of opened calyx is seen at upper right; hairs on margins of lobes are omitted. (Inflorescence and details from Type-GH; large leaf from *Moore & Wood 4586*-GH.)

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BIOMETRIC STUDIES, I.

Floral Characters in Six North American Species of Iris

By

Robert C. Foster

Introduction

The present paper is the result of a long-standing interest in the possibility of applying objective methods to what some have called one of the last scientific strongholds of subjectivity—plant taxonomy. In recent years, there has been much discussion of how plant taxonomy can be objectified, but rarely, if ever, has the right question, "Can plant taxonomy be objectified?", first been asked, or answered. Woodson (1947) has shown that in some aspects, at least, the question can be answered in the affirmative. It is hoped that these exploratory notes will show that in other respects objective methods can be utilized. At the same time, certain failures will be pointed out. For this work, linear measurements of nine floral characters in six North American species of *Iris* have been studied.

As one passes from the purely descriptive level of a survey of newly or recently opened floristic areas, with scanty materials available for study, to the different levels of more detailed investigation of better-known and more thoroughly collected areas, and intensive monographic revisions of genera, it seems desirable, and should be inevitable, that, in some phases, additional tools of investigation be used. Among these tools, the application of the quantitative methods of biometry must be numbered. Most taxonomists, I believe, use statistical data, even if only in a relatively crude and ungrouped form. It is only natural, then, for them to use a more refined and intensified extension of these earlier approximations, in groups of especial interest to them, at least. Investigations of this nature cannot be a negation of conventional taxonomy, but serve, instead, to strengthen it. To treat all levels of taxonomic inquiry with the same low intensity suitable to the exploratory-descriptive phase is to misevaluate taxonomic possibilities, and thus to do a disservice to the science.

As has been intimated, this is a purely exploratory paper. In view of the paucity of available data, it could be nothing else.

Extrapolation of results from the populations studied to the species involved, without qualifying, would be a serious blunder. Nevertheless, the results presented suggest that the continuance and intensification of this mode of inquiry would be fruitful in many ways, although comparatively barren in others. It is quite possible that untenable hypotheses and erroneous suggestions may be made here, but the purpose of this paper is, to repeat, exploratory, to examine possibilities for further study, not to endeavor to reach final conclusions on presently-limited evidence.

To a number of people, but in particular to Dr. P. A. Munz, Dr. Lincoln Constance, and Dr. E. C. Abbe, I am grateful for interest in this study and for encouragement of its continuance.

Materials and Methods

For this study, the following North American species of *Iris* were chosen: *I. versicolor* L., *I. virginica* L., *I. macrosiphon* Torr., *I. amabilis* Eastw.,* *I. Munzii* R. C. Foster, and *I. prismatica* Pursh, all members of § *Apogon*. Nine floral characters were selected for measurement: perianth-tube-length, sepal-length, maximum sepal-width, petal-length, maximum petal-width, style-arm-length, style-crest-length, anther-length, and filament-length. In the case of *I. versicolor* and *I. virginica*, the data were taken from Anderson's paper (1928). His measurements, made on living material, did not include tube-length, style-arm-length, nor filament-length, but did include two measures which have not been used here, sepal-taper and petal-taper. All other measurements have been made on herbarium specimens, without dissection, chiefly by transmitted light. This has automatically reduced greatly the number of measurements which could be made, since only well-prepared flowers could be measured, and the flowers of *Iris* are difficult to press. All measurements were made with a hand-lens or a dissecting-microscope, to the nearest millimeter. In the following section, Table I summarizes the number of measurements made for each character in each species.

For each character in all the species considered, the mean, standard deviation, and coefficient of variation, with their respective standard errors, were determined. A synoptic table of this information is given as Table II. Then the three sta-

* This is the plant usually called *I. californica*, but as there is some question of the proper publication of that name, and doubt as to the original application of the name, I prefer to use *I. amabilis*, a binomial which is definite and associated with a type-specimen.

tistical estimates for each character in *I. macrosiphon* were compared with the same estimates for the same characters in all the other species, to find the difference (d) between the means, the standard deviations and the coefficients of variation. This process was repeated until all species had been compared with one another. The standard error of each difference (σ_d) was then calculated, in order to test the significance of the differences. This is essentially a t-test for significance, but instead of using Fisher's table of probability (Fisher (1948), p. 174), it seemed preferable, for purposes of tabular display, to use the older method of dividing d by its standard error. These values of d/σ_d are given in Tables III–X. Ordinarily, if $d/\sigma_d \geqq 3$, the difference is regarded as significant, indicating a real difference in the populations thus compared. This, however, is true in the case of statistical estimates derived from large series of observations. As a result, in view of the small number of observations available here, except in the case of *I. versicolor* and *I. virginica*, it has seemed advisable to treat values of d/σ_d of less than 6 or 7 as being probably not significant, and even this may be too low an estimate. This conservatism is even more justified in comparing measurements of pressed material with the measurements of living material of *I. versicolor* and *I. virginica;* in these cases, the threshold of significance is unquestionably higher.

The standard deviations were compared in this manner since it was thought that, even if there were no significant difference between the means, there might be a significant difference in the dispersion of the variates around the means. The coefficients of variation were similarly compared to see if there were any significant difference between the variabilities of a character in two populations.

Finally, for each species, a series of correlation coefficients was worked out for all possible character-combinations. These are given, with their approximate probabilities, in Table XI. The values of P were taken from the table given by Fisher (1948, p. 209).

Since the original measurements, in centimeters, were made to one decimal place, all calculations have been reduced to two decimal places before publication. As the values of d/σ_d are subject to so large a margin of error, only one decimal place has been used in the final version. Although all calculations have been carefully checked and rechecked, it is too much to hope that all arithmetical errors have been detected; it is hoped, however, that these are at a minimum.

Discussion

This work was originally begun as an inquiry as to the results of the application of rather elementary and conventional statistical methods to the extensive data given by Anderson (1928) in his highly interesting, at that time unorthodox, study of quantitative floral differences between *I. versicolor* and *I. virginica*, two closely related species which had been regarded by Dykes (1913) as conspecific. Anderson concluded that the quantitative differences shown by his method of investigation, especially when considered with other differences, amply justified the separation of the two.

A glance at the values of d/σ_d for the comparison of the two species, Table X, shows that the means are significantly different in seven of the eight characters examined. In sepal-length, petal-taper, style-crest-length, and anther-length, there are also significant differences in the dispersion of the variates around the means. Comparison of the coefficients of variation shows significant differences of variability in sepal-length, petal-length, petal-width, petal-taper, and style-crest-length. It seems possible that these differences in variability are associated with the presumed origin of *I. versicolor* as an amphidiploid hybrid between *I. virginica* and *I. setosa* var. *interior* Anderson (Anderson (1936)).

Even if no other differences, quantitative or qualitative, existed, the significant differences shown in floral characters, I think, strongly support Anderson's conclusion as to the distinctness of the two species. The data available warrant extrapolation from the populations studied to the species as species.

The other species to be considered were carefully chosen because of certain morphological resemblances and dissimilarities. *I. macrosiphon* and *I. amabilis* have sometimes been united (Foster (1937)), or, although obviously close, have sometimes been separated, as by Abrams (1923), on the basis of the greater stem-length and shorter perianth-tube of *I. amabilis* (*I. californica* in Abrams' treatment). In contrast, another member of the same subsection, *Californicae*, was chosen, *I. Munzii*, with much larger flowers and a short perianth-tube. Finally, a species of eastern North America, *I. prismatica*, in the related subsection *Sibiricae*, was selected because, although its flowers are of much the same size as those of *I. macrosiphon* and *I. amabilis*, its perianth-tube is very short.

Since in the case of *I. macrosiphon*, only 44 sets of nine measurements from each flower were secured for working out correlation

coefficients, this second population-level has also been compared with the other species. Similarly, only 22 sets of nine measurements could be secured for correlation coefficients in *I. amabilis*. By omitting sepal- and petal-widths, it was possible to secure 46 sets of seven measurements for *I. amabilis*. The tabular comparisons of differences include all three population-levels.

In Tables III and IV, the two population-levels for *I. macrosiphon* are compared with the other species, the arrangement being in systematic sequence from left to right. The difference of the means of tube-length (Table III) shows significant values only in comparison with *I. Munzii* and *I. prismatica*. These values of d/σ_d are so high that it seems safe to say that the samples are representative of the species concerned, in this character at least. If larger population-samples of *I. macrosiphon* and *I. amabilis* give a similar low value of d/σ_d for the means of tube-length, it would appear that there is no significant difference between these two in this character. Indeed, the data for the means of *I. macrosiphon* and *I. amabilis* (Table III) suggest, in most characters, that significant differences may not exist. If that is the case, either other quantitative differences which are significant must be found, or reliance must be placed on qualitative differences. A difference in stem-length has been mentioned, but in the field this breaks down. In 1937, I collected *I.*

Presentation of Data

TABLE I

Number of Observations Available

Character	Macro-siphon	Ama-bilis	Munzii	Pris-matica	Versi-color	Virgi-nica
Tube-length	103	105	42	25	—	—
Sepal-length	90	75	42	25	566	1560
Sepal-width	71	40	42	25	565	1594
Petal-length	83	47	42	25	562	1590
Petal-width	49	24	42	25	556	1628
Style-arm	92	78	42	25	—	—
Style-crest	89	77	42	25	382	1329
Anther	94	80	42	25	241	415
Filament	94	79	42	25	—	—

Note: In addition, a second population-level for *I. macrosiphon*, with 44 measurements for each character, and two levels for *I. amabilis*, with 46 measures for each character (sepal-width and petal-width omitted) and 22 measures for each character (sepal-width and petal-width included), have been utilized.

macrosiphon well to the north of the type-locality (my no. 240), typical in most respects, but with stems up to 24 cm. long. No other *Iris* was seen for many miles, so that hybridization seems ruled out. An even taller variant, with stems up to 60 cm. long, has since been described as *I. macrosiphon* var. *elata* Eastw. The suspicion inevitably arises that *I. amabilis* and *I. macrosiphon* are not specifically distinct. I feel that two entities are involved, but their relative status is dubious at present.

The comparison of *I. macrosiphon* and *I. amabilis* can be concluded with brief reference to differences in standard deviations

TABLE II

Means

Character	Macrosiphon	Macrosiphon (44)	Amabilis	Amabilis (46)
Tube-length	4.55 ±0.12	5.18 ±0.18	3.95 ±0.05	3.99 ±0.13
Sepal-length	4.48 ±0.06	4.93 ±0.10	5.03 ±0.08	5.16 ±0.07
Sepal-width	1.39 ±0.04	1.41 ±0.06	1.51 ±0.04	——
Petal-length	4.23 ±0.07	4.42 ±0.11	4.68 ±0.07	4.63 ±0.07
Petal-width	0.75 ±0.03	0.75 ±0.03	0.76 ±0.04	——
Style-arm	2.50 ±0.03	2.55 ±0.04	2.61 ±0.05	2.69 ±0.05
Style-crest	1.11 ±0.02	1.20 ±0.07	1.10 ±0.02	1.11 ±0.03
Anther	1.18 ±0.02	1.19 ±0.03	1.34 ±0.02	1.15 ±0.04
Filament	1.21 ±0.02	1.17 ±0.04	1.16 ±0.01	1.28 ±0.03
Standard Deviations				
Tube-length	1.23 ±0.09	1.18 ±0.13	0.48 ±0.03	0.91 ±0.10
Sepal-length	0.57 ±0.04	0.64 ±0.07	0.58 ±0.04	0.54 ±0.06
Sepal-width	0.30 ±0.03	0.39 ±0.04	0.26 ±0.03	——
Petal-length	0.59 ±0.05	0.71 ±0.08	0.46 ±0.05	0.50 ±0.05
Petal-width	0.19 ±0.02	0.17 ±0.02	0.22 ±0.03	——
Style-arm	0.33 ±0.02	0.29 ±0.03	0.40 ±0.03	0.35 ±0.04
Style-crest	0.21 ±0.02	0.49 ±0.05	0.21 ±0.02	0.22 ±0.02
Anther	0.19 ±0.01	0.19 ±0.03	0.16 ±0.02	0.25 ±0.03
Filament	0.22 ±0.02	0.25 ±0.03	0.09 ±0.01	0.17 ±0.02
Coefficients of Variation				
Tube-length	27.03 ±12.27	22.77 ±4.14	11.94 ±0.84	23.27 ±2.55
Sepal-length	12.74 ±0.18	12.98 ±0.07	11.60 ±0.74	10.46 ±1.10
Sepal-width	21.58 ±1.89	27.65 ±3.16	17.21 ±1.98	——
Petal-length	13.94 ±1.10	16.06 ±1.73	9.71 ±1.01	10.79 ±1.14
Petal-width	25.33 ±2.70	22.66 ±2.55	28.42 ±4.42	——
Style-arm	13.20 ±0.99	11.37 ±1.23	15.31 ±1.25	13.01 ±1.38
Style-crest	18.91 ±1.47	40.83 ±5.02	19.09 ±1.04	19.81 ±2.15
Anther	16.10 ±1.20	15.96 ±1.74	12.03 ±0.97	21.73 ±2.37
Filament	18.18 ±1.37	21.36 ±2.38	7.53 ±0.60	13.28 ±1.41

and coefficients of variation. For the latter, d/σ_d for filament-length is the only value showing a possibly significant difference of variability in the populations studied. There is a possibly significant difference between the standard deviations for this same character and a difference in dispersion of the variates for tube-length.

Reference has already been made to the high value (31.1) of d/σ_d for the means of tube-length in *I. macrosiphon* and *I. Munzii*. Similar high values are found for every character studied, except filament-length. No significant differences are found in the

TABLE II—*Continued*

Amabilis (22)	Munzii	Prismatica	Versicolor	Virginica
Means				
4.16 ±0.09	0.82 ±0.03	0.45 ±0.01	——	——
5.21 ±0.08	7.49 ±0.12	4.29 ±0.08	5.49 ±0.03	5.85 ±0.02
1.49 ±0.06	2.82 ±0.06	1.46 ±0.06	2.73 ±0.02	2.63 ±0.01
4.89 ±0.09	6.80 ±0.12	3.68 ±0.07	3.65 ±0.03	4.85 ±0.02
0.75 ±0.05	1.57 ±0.05	0.95 ±0.03	1.27 ±0.01	1.66 ±0.01
2.81 ±0.07	3.41 ±0.05	2.40 ±0.05	——	——
1.12 ±0.04	1.59 ±0.05	0.74 ±0.03	1.09 ±0.01	1.26 ±0.004
1.39 ±0.04	2.16 ±0.05	1.04 ±0.03	1.27 ±0.01	1.47 ±0.01
1.21 ±0.05	1.11 ±0.03	1.19 ±0.02	——	——
Standard Deviations				
0.43 ±0.07	0.17 ±0.02	0.06 ±0.01	——	——
0.38 ±0.06	0.80 ±0.09	0.41 ±0.06	0.60 ±0.01	0.78 ±0.01
0.29 ±0.04	0.39 ±0.04	0.29 ±0.04	0.41 ±0.01	0.41 ±0.01
0.41 ±0.07	0.75 ±0.08	0.34 ±0.05	0.65 ±0.02	0.62 ±0.01
0.22 ±0.03	0.30 ±0.03	0.16 ±0.02	0.33 ±0.01	0.35 ±0.01
0.34 ±0.05	0.34 ±0.04	0.27 ±0.04	——	——
0.20 ±0.03	0.29 ±0.03	0.14 ±0.02	0.18 ±0.01	0.14 ±0.003
0.17 ±0.03	0.31 ±0.03	0.14 ±0.02	0.15 ±0.01	0.19 ±0.01
0.21 ±0.03	0.18 ±0.02	0.09 ±0.02	——	——
Coefficients of Variation				
10.33 ±0.17	20.22 ±2.86	14.00 ±2.02	——	——
7.29 ±1.11	10.72 ±1.82	9.55 ±1.36	10.87 ±0.33	13.29 ±0.24
19.46 ±3.04	13.79 ±1.53	20.54 ±3.03	14.99 ±0.46	15.66 ±0.28
8.38 ±1.01	11.08 ±1.22	9.23 ±1.31	17.39 ±0.53	12.79 ±0.23
29.33 ±4.79	19.32 ±2.19	16.84 ±2.45	26.17 ±0.78	20.81 ±0.37
12.09 ±1.85	9.93 ±1.09	11.25 ±1.33	——	——
17.85 ±2.78	18.24 ±2.06	18.91 ±1.15	16.23 ±0.60	11.27 ±0.22
12.23 ±1.87	14.30 ±1.59	13.46 ±1.94	11.60 ±0.54	12.93 ±0.46
17.35 ±2.69	16.22 ±1.81	7.64 ±1.09	——	——

coefficients of variation, but the difference between the standard deviations for tube-length in the two populations is significant. On the basis of herbarium-study and field-knowledge, I should, in the case of the means, unhesitatingly extrapolate from the immediate populations studied and say that the differences shown by these few observations are evidence of inherent specific differences.

Comparison of the means of *I. macrosiphon* and *I. prismatica*

TABLE III

Values of d/σ_d for *Iris macrosiphon* compared with the following species:

Character	Amabilis	Amabilis (46)	Amabilis (22)	Munzii	Prismatica	Versicolor	Virginica
			Means				
Tube-length	4.6	3.1	2.6	31.1	34.2	—	—
Sepal-length	2.7	1.7	1.1	15.4	9.5	2.0	7.4
Sepal-width	2.0	—	1.4	20.4	1.0	26.4	31.0
Petal-length	4.0	4.0	6.0	18.4	5.5	7.3	8.6
Petal-width	0.2	—	0	13.7	5.0	17.3	30.3
Style-arm	1.6	3.3	3.9	15.8	1.7	—	—
Style-crest	0.3	0	0.2	9.6	9.3	1.0	7.5
Anther	5.3	0.6	4.2	19.6	3.5	4.5	14.5
Filament	1.7	1.8	0	2.5	0.7	—	—
			Standard Deviations				
Tube-length	7.6	2.3	7.3	11.8	13.0	—	—
Sepal-length	1.0	1.3	3.3	1.6	2.9	0.7	2.3
Sepal-width	1.0	—	0.2	1.8	0.2	3.7	3.7
Petal-length	1.9	1.3	2.0	1.8	3.6	1.2	0.6
Petal-width	0.8	—	0.8	2.7	1.0	7.0	8.0
Style-arm	1.8	0.4	0.2	0.2	1.2	—	—
Style-crest	0	0.3	0.3	2.0	2.3	1.5	3.5
Anther	3.0	2.0	0.7	4.0	2.5	4.0	0
Filament	6.5	1.7	0.3	1.3	3.3	—	—
			Coefficients of Variation				
Tube-length	1.2	0.3	0.6	0.5	1.1	—	—
Sepal-length	0.4	1.9	3.3	1.4	1.5	1.2	1.4
Sepal-width	1.6	—	0.6	3.2	0.3	3.4	3.1
Petal-length	2.8	2.0	3.8	1.7	2.8	2.8	1.0
Petal-width	0.6	—	0.7	2.7	2.3	0.3	1.7
Style-arm	1.3	0.1	0.5	2.2	1.2	—	—
Style-crest	0.1	0.4	0.3	0.3	0	1.7	5.2
Anther	2.6	2.1	1.7	0.9	1.1	3.4	2.5
Filament	7.1	2.5	0.3	0.9	6.0	—	—

presents another picture. Between the means of tube-length and sepal-length, there is a very real difference. The only other difference which may be significant is that between the means of the style-crests. In the standard deviations, a significant difference again is shown for tube-length, but no significant differences are shown by the coefficients of variation in the two populations. In other words, the probability seems rather strong that so far as floral measurements are concerned, the kind

TABLE IV

Values of d/σ_d for *I. macrosiphon* (44) compared with the following species:

Character	Amabilis	Amabilis (46)	Amabilis (22)	Munzii	Prismatica	Versicolor	Virginica
			Means				
Tube-length	6.5	5.4	5.1	24.2	26.3	—	—
Sepal-length	0.8	1.9	2.2	14.8	4.9	5.6	9.2
Sepal-width	1.4	—	0.9	15.7	0.6	22.0	20.3
Petal-length	2.0	1.6	2.8	8.6	5.7	7.0	3.9
Petal-width	0.2	—	0	13.7	5.0	17.3	30.3
Style-arm	1.0	2.3	3.3	14.3	2.5	—	—
Style-crest	1.4	1.1	1.0	4.3	5.8	1.6	0.8
Anther	3.8	0.8	4.0	1.2	3.8	2.7	8.7
Filament	0.3	2.2	0.7	16.2	0.4	—	—
			Standard Deviations				
Tube-length	5.5	1.7	5.0	7.8	8.6	—	—
Sepal-length	0.8	1.1	2.9	1.5	2.6	0.6	2.0
Sepal-width	2.6	—	1.7	0	1.7	0.5	0.5
Petal-length	2.8	2.3	2.7	0.4	4.1	0.8	1.1
Petal-width	1.3	—	1.3	3.3	0.3	8.0	9.0
Style-arm	2.8	1.2	0.8	1.0	0.4	—	—
Style-crest	5.6	4.5	4.8	6.7	7.0	6.2	6.7
Anther	1.5	1.5	0.5	1.8	1.7	2.0	0
Filament	5.3	2.0	1.0	3.0	4.0	—	—
			Coefficients of Variation				
Tube-length	2.6	0.1	3.0	0.5	1.9	—	—
Sepal-length	0.5	0.8	1.8	0.7	1.1	0.8	0.1
Sepal-width	3.0	—	1.9	5.0	1.6	4.0	3.8
Petal-length	3.1	2.6	3.8	2.4	3.3	0.9	1.9
Petal-width	1.1	—	1.2	1.0	1.4	1.3	0.7
Style-arm	2.3	0.9	0.3	0.9	0.1	—	—
Style-crest	4.3	3.9	4.0	4.2	4.3	4.9	5.9
Anther	2.0	2.0	1.5	1.4	1.0	2.4	1.7
Filament	5.7	2.9	1.1	0.7	5.1	—	—

of statistical treatment used here will be unrevealing, even with a larger group of data. Consequently, either other quantitative differences must be sought, or use must be made of qualitative differences. Actually, there is little likelihood of confusing the two species, but the apparent failure of this biometric treatment is a clear indication of its uselessness in some cases. This should not discourage attempts at quantitative treatment, however, since it would, for instance, be misleading to chop off the extreme ends of a normal curve of variation and describe the

TABLE V

Values of d/σ_d for *I. amabilis* compared with the following species:

Character	Munzii	Prismatica	Versicolor	Virginica
		Means		
Tube-length	52.2	68.7	—	—
Sepal-length	17.6	6.7	5.1	10.3
Sepal-width	18.7	0.7	24.4	28.0
Petal-length	15.1	10.0	12.9	2.1
Petal-width	13.5	3.8	12.8	22.5
Style-arm	11.4	3.0	—	—
Style-crest	9.1	9.0	0.5	8.0
Anther	15.2	7.5	3.5	6.5
Filament	1.7	1.4	—	—
		Standard Deviations		
Tube-length	7.5	12.8	—	—
Sepal-length	2.2	2.4	0.5	5.0
Sepal-width	2.6	0.6	5.0	5.0
Petal-length	3.2	1.7	3.8	3.2
Petal-width	2.0	1.5	3.7	4.3
Style-arm	1.2	2.6	—	—
Style-crest	2.0	2.3	1.5	3.3
Anther	5.0	1.0	1.0	3.0
Filament	4.5	0	—	—
		Coefficients of Variation		
Tube-length	2.8	0.9	—	—
Sepal-length	0.6	1.3	0.9	2.2
Sepal-width	1.4	0.9	1.1	0.8
Petal-length	0.9	0.3	6.7	3.0
Petal-width	1.9	2.3	0.5	1.7
Style-arm	3.2	2.2	—	—
Style-crest	0.4	0.1	2.4	7.5
Anther	1.2	0.7	0.4	0.8
Filament	4.6	0.1	—	—

extremes as varieties (or species), dismissing a rather large number of variates, clustered around the mean, as "intermediates," when, in actuality, this group, not the extremes, should be in primary focus.

Little need be said in comparing *I. macrosiphon* with *I. versicolor* and *I. virginica*. For the means of sepal-length and -width, and petal-width, high values of d/σ_d are shown, undoubtedly indicative of real specific differences in these characters. The only other fairly high value occurs in the comparison of anther-lengths in *I. macrosiphon* and *I. virginica*. No unquestionably significant differences are shown in the comparisons of standard deviations and coefficients of variation.

TABLE VI

Values of d/σ_d for *I. amabilis* (46) compared with the following species:

Character	Munzii	Prismatica	Versicolor	Virginica
		Means		
Tube-length	24.4	27.2	——	——
Sepal-length	16.7	7.9	4.1	9.4
Petal-length	15.5	9.5	12.3	3.1
Style-arm	10.3	4.1	——	——
Style-crest	8.0	9.3	0.7	5.0
Anther	16.8	2.2	3.0	8.0
Filament	4.3	2.3	——	——
		Standard Deviations		
Tube-length	7.4	8.5	——	——
Sepal-length	2.4	1.4	1.0	4.0
Petal-length	2.8	2.3	3.0	2.4
Style-arm	0.2	1.3	——	——
Style-crest	1.8	2.7	2.0	4.0
Anther	1.5	2.8	3.3	2.0
Filament	0.3	2.7	——	——
		Coefficients of Variation		
Tube-length	0.8	2.9	——	——
Sepal-length	0.2	0.5	0.4	2.5
Petal-length	0.2	0.9	5.2	1.7
Style-arm	1.8	0.9	——	——
Style-crest	0.5	0.4	1.6	4.0
Anther	2.6	2.0	4.2	3.7
Filament	1.3	3.2	——	——

Note: Only by the omission of sepal-width and petal-width could 46 sets of observations be secured.

From the comparisons previously made between *I. macrosiphon* and *I. amabilis*, it is hardly surprising that the comparison of *I. amabilis* with the remaining species presents the same general picture, with a few differences in the case of the means of some characters of *I. versicolor* and *I. virginica* (see Table V in particular, and Tables VI and VII for the similar comparisons of the lower population-levels of *I. amabilis*).

The population of *I. Munzii*, a member of the *Californicae*, shows much the same relations to *I. prismatica*, *I. versicolor* and

TABLE VII

Values of d/σ_d for *I. amabilis* (22) compared with the following species:

Character	Munzii	Prismatica	Versicolor	Virginica
	Means			
Tube-length	17.6	41.2	——	——
Sepal-length	12.7	8.4	3.1	8.0
Sepal-width	14.8	0.3	20.7	19.0
Petal-length	12.7	11.0	12.4	0.4
Petal-width	11.7	3.3	10.4	18.2
Style-arm	6.7	4.6	——	——
Style-crest	7.8	7.6	0.8	3.3
Anther	12.8	7.0	3.0	2.0
Filament	1.7	0.4	——	——
	Standard Deviations			
Tube-length	3.7	5.3	——	——
Sepal-length	3.8	0.3	3.7	6.7
Sepal-width	1.7	0	3.0	3.0
Petal-length	3.1	0.8	3.4	3.0
Petal-width	2.0	1.5	3.7	4.3
Style-arm	0	1.2	——	——
Style-crest	2.3	1.5	0.7	2.0
Anther	3.5	0.8	0.7	0.7
Filament	0.8	4.0	——	——
	Coefficients of Variation			
Tube-length	3.5	1.8	——	——
Sepal-length	2.1	1.3	3.1	5.3
Sepal-width	1.7	0.3	1.6	1.3
Petal-length	1.7	0.5	7.9	4.2
Petal-width	1.9	2.1	0.7	1.8
Style-arm	1.0	0.4	——	——
Style-crest	0.1	0.4	0.6	2.7
Anther	0.8	0.5	0.3	0.4
Filament	0.4	3.4	——	——

I. virginica as its distinct relatives, *I. macrosiphon* and *I. amabilis* (see Table VIII). For the means, significant values of d/σ_d occur in all characters except filament-length, in the comparison with *I. prismatica*. Non-significant differences in sepal-width and petal-width appear on comparison with *I. virginica* and *I. versicolor*, the other differences being significant. No significant values of d/σ_d occur in the comparison of standard deviations or coefficients of variation.

Although the small population of *I. prismatica* showed almost

TABLE VIII

Values of d/σ_d of *I. Munzii* compared with the following species:

Character	Prismatica	Versicolor	Virginica
	Means		
Tube-length	12.3	——	——
Sepal-length	22.9	16.7	13.7
Sepal-width	15.1	1.5	3.2
Petal-length	22.3	26.3	16.3
Petal-width	10.3	6.0	1.8
Style-arm	14.4	——	——
Style-crest	14.2	10.0	6.6
Anther	18.7	17.8	13.8
Filament	2.0	——	——
	Standard Deviations		
Tube-length	4.6	——	——
Sepal-length	3.7	2.2	0.2
Sepal-width	1.7	0.5	0.5
Petal-length	4.6	1.3	1.7
Petal-width	3.5	1.0	1.7
Style-arm	1.2	——	——
Style-crest	3.8	3.7	4.7
Anther	4.7	5.3	4.0
Filament	3.0	——	——
	Coefficients of Variation		
Tube-length	1.8	——	——
Sepal-length	0.7	0.1	2.1
Sepal-width	1.6	0.8	1.2
Petal-length	1.0	4.7	1.4
Petal-width	0.8	2.9	0.6
Style-arm	0.8	——	——
Style-crest	0.3	0.9	3.4
Anther	0.3	1.6	0.8
Filament	4.1	——	——

TABLE IX

Values of d/σ_d for *I. prismatica* compared with the following species:

Character	Versicolor	Virginica
	Means	
Sepal-length	13.3	19.5
Sepal-width	21.2	19.5
Petal-length	0.4	16.7
Petal-width	10.7	23.7
Style-crest	11.7	17.3
Anther	7.7	14.3
	Standard Deviations	
Sepal-length	3.2	6.7
Sepal-width	3.0	3.0
Petal-length	6.2	5.6
Petal-width	8.5	9.5
Style-crest	2.0	0
Anther	0.5	2.5
	Coefficients of Variation	
Sepal-length	0.9	1.9
Sepal-width	1.8	1.6
Petal-length	5.8	2.7
Petal-width	3.6	1.6
Style-crest	2.0	6.5
Anther	0.9	0.3

TABLE X

Values of d/σ_d for *I. versicolor* compared with *I. virginica*

Character	Means	S. D.	C. V.
Sepal-length	11.3	12.1	6.4
Sepal-width	4.2	0.2	1.2
Sepal-taper	3.9	2.8	0.8
Petal-length	40.0	1.1	8.1
Petal-width	24.4	1.4	6.1
Petal-taper	1.4	17.8	11.9
Style-crest	17.5	5.6	5.7
Anther	12.9	4.6	2.6

TABLE XI

Correlation coefficients and their corresponding probabilities (P)

Characters	Macrosiphon r	Macrosiphon P	Amabilis (22) r	Amabilis (22) P	Amabilis (46) r	Amabilis (46) P	Munzii r	Munzii P	Prismatica r	Prismatica P
Tube and sepal-length	+0.52	<0.01	−0.33	>0.1	+0.16	>0.1	+0.04	>0.1	+0.19	>0.1
Tube and sepal-width	+0.31	0.5–0.2	+0.41	>0.05	.....		−0.22	>0.1	−0.01	>0.1
Tube and petal-length	+0.51	<0.01	−0.76	<0.01	+0.11	>0.1	−0.05	>0.1	+0.19	>0.1
Tube and petal-width	+0.25	>0.1	−0.42	±0.05	.....		−0.25	±0.1	+0.02	>0.1
Tube and style-arm	+0.80	<0.01	−0.76	<0.01	−0.06	>0.1	+0.12	>0.1	+0.21	>0.1
Tube and style-crest	+0.28	±0.05	.....		+0.38	<0.01	+0.87	<0.01	+0.14	>0.1
Tube and anther	+0.11	>0.1	−0.76	<0.01	−0.21	>0.1	+0.20	>0.1	+0.79	<0.01
Tube and filament	+0.25	±0.1	−0.57	<0.01	+0.08	>0.1	−0.55	<0.01	−0.52	<0.01
Sepal-length and sepal-width	+0.48	<0.01	+0.65	<0.01	.....		+0.61	<0.01	+0.75	<0.01
Sepal-length and petal-length	+0.78	<0.01	+0.95	<0.01	+0.74	<0.01	+0.70	<0.01	+0.92	<0.01
Sepal-length and petal-width	+0.50	<0.01	+0.11	>0.1	.....		+0.52	<0.01	+0.74	<0.01
Sepal-length and style-arm	+0.73	<0.01	+0.85	<0.01	+0.70	<0.01	+0.67	<0.01	+0.68	<0.01
Sepal-length and style-crest	+0.32	0.05–0.02	+0.56	<0.01	+0.47	<0.01	+0.37	<0.02	+0.22	>0.1
Sepal-length and anther	+0.36	±0.02	+0.51	>0.01	+0.48	<0.01	+0.08	>0.1	+0.07	>0.1
Sepal-length and filament	+0 50	<0.01	+0.47	<0.05	+0.45	<0.01	+0.21	>0.1	+0.32	>0.1
Sepal-width and petal-length	+0.82	<0.01	+0.21	>0.1	.....		+0.69	<0.01	+0.52	±0.01
Sepal-width and petal-width	+0.29	0.1–0.05	+0.13	>0.1	.....		+0.88	<0.01	+0.60	<0.01
Sepal-width and style-arm	+0.50	<0.01	+0.28	>0.1	.....		+0.40	>0.01	+0.30	>0.1
Sepal-width and style-crest	+0.12	>0.1	+0.34	>0.1	.....		+0.07	>0.1	+0.25	>0.1
Sepal-width and anther	+0.05	>0.1	+0.20	>0.1	.....		−0.21	>0.1	+0.04	>0.1
Sepal-width and filament	+0.18	>0.1	+0.22	>0.1	.....		+0.42	>0.01	+0.40	±0.05
Petal-length and petal-width	+0.37	0.02–0.01	+0.16	>0.1	.....		+0.53	<0.01	+0.28	>0.1
Petal-length and style-arm	+0.71	<0.01	+0.45	>0.02	+0.46	<0.01	+0.60	>0.01	+0.52	±0.01
Petal-length and style-crest	+0.29	±0.05	+0.19	>0.1	+0.27	>0.05	+0.22	>0.1	+0.22	>0.1
Petal-length and anther	+0.33	0.05–0.02	+0.54	<0.01	+0.64	<0.01	+0.30	>0.05	+0.37	0.1–0.05
Petal-length and filament	+0.42	±0.01	+0.57	<0.01	+0.35	<0.02	+0.40	<0.01	+0.12	>0.1
Petal-width and style-arm	+0.34	0.05–0.02	+0.05	>0.1	.....		+0.31	<0.05	+0.19	>0.1
Petal-width and style-crest	+0.20	>0.1	+0.12	>0.1	.....		+0.05	>0.1	+0.06	>0.1
Petal-width and anther	+0.12	>0.1	−0.05	>0.1	.....		+0.09	>0.1	+0.03	>0.1
Petal-width and filament	+0.02	>0.1	+0.20	>0.1	.....		+0.33	0.05–0.02	+0.16	>0.1
Style-arm and style-crest	+0.28	0.1–0.05	+0.39	>0.05	+0.46	<0.01	+0.43	<0.01	+0.27	>0.1
Style-arm and anther	+0.31	0.1–0.05	+0.46	>0.02	+0.57	<0.01	+0.18	>0.1	+0.38	0.1–0.05
Style-arm and filament	+0.66	<0.01	+0.19	>0.1	+0.42	<0.01	+0.59	<0.01	+0.22	>0.1
Style-crest and anther	+0.18	>0.1	+0.09	>0.1	+0.10	>0.1	+0.35	±0.02	+0.53	±0.01
Style-crest and filament	+0.02	>0.1	−0.04	>0.1	+0.35	<0.02	−0.17	>0.1	+0.14	>0.1
Anther and filament	−0.05	>0.1	+0.53	±0.01	+0.38	<0.01	+0.05	>0.1	+0.03	>0.1

no significant differences of means when compared with the *Californicae*, comparison of the means with *I. versicolor* and *I. virginica* shows a series of high values for d/σ_d (Table IX). The only non-significant value is for the difference of the petal-length means of *I. prismatica* and *I. versicolor*. On the whole, the picture is what might have been expected by a non-statistical taxonomist and I doubt if an increase in the population-size for *I. prismatica* would result in any drastic alteration of values. No significant differences seem to exist between the coefficients of variation, but a few possibly significant differences in dispersion are shown in the comparison of the standard deviations.

Throughout the foregoing discussion, the word "significant" has been used primarily in the sense of "statistically significant." Statistically significant high values of d/σ_d probably represent biologically real differences between the populations studied, or even between the species involved. Nevertheless, it is difficult to see how some of these differences can have biological significance. For example, the difference between the means of petal-width in the populations of *I. versicolor* and *I. virginica* is only a little over 4 mm. How can this be of biological significance? Yet d/σ_d is 20.0, indicating a real specific difference. Such differences, it seems to me, should be called biologically neutral differences, whose existence is real and of importance to the taxonomist endeavoring to differentiate between species.

As a final step, correlation coefficients (r) for all character-combinations in four species were calculated (including two population-levels in *I. amabilis*) (Table XI). The data for *I. versicolor* and *I. virginica* did not permit the inclusion of these species in this aspect of the work. If development of these floral characters were controlled by single genes, it might have been possible to work out a few hypothetical linkage-groups which might be tested by breeding experiments. The problem seems, however, to be far more complex. Many combinations show only a weak correlation or none significantly different from zero. It may be objected that the populations are too small for the correlation coefficients to have meaning. Nevertheless, recognizing that biological observations may be scanty, Fisher (1948, p. 209) has constructed a special table for estimating the probability of correlation coefficients derived from 100 or fewer pairs of observations. He states (l. c., p. 193): "In testing the significance of an observed correlation we require to calculate the probability that such a correlation should arise, by random sampling, from an uncorrelated population. If the probability

is low we regard the correlation as significant." Accordingly, the approximate values of P have been included in Table XI. These were determined before the correlation coefficients were reduced from four to two decimal places, since Fisher gave probabilities on the basis of four decimal places.

So far as the correlation of perianth-tube-length with other characters is concerned, values of r tend to be low and values of P high in the populations studied. In other character-combinations, there tends to emerge a somewhat similar correlation-pattern in passing from one species to another. As indicated by the low values of P, there seems, for example, to be a definite correlation, although sometimes weak, between sepal-length and sepal-width, sepal-length and petal-length, sepal-length and petal-width, sepal-length and style-arm-length, and sepal-length and filament-length. Aside from these, there are few values of r with low values of P. Most of these occur in combinations of sepal-width and petal-length with other characters. It is possible, of course, that more data would produce significantly different correlation coefficients. It is possible, too, that different genes modifying the interrelationship of the characters are present in the populations studied. On the whole, the use of correlation coefficients seems less rewarding, for this particular work, than the comparison of the means. Yet, it is certainly significant that the correlation coefficients in *I. amabilis* are generally of the same order of value and of similar probabilities as those in *I. macrosiphon*, an additional point against the conplete separation of these two entities as species.

As a non-statistician, I have perhaps tried to extract too much from insufficient data, but extrapolation from a small population to a species has been done only as the result of additional knowledge gained from herbarium-study or field-study. Furthermore, even a taxonomist should be forgiven for occasionally attempting to approach more closely to the biological realities which he must otherwise petrify in a nearly static frame of reference. It is hoped that this study has shown the possible value of such a quantitative treatment, as well as some of the weakness. The conviction that the taxonomist cannot rely solely on quantitative methods remains. I grant the desirability of eliminating the subjective element as far as possible, but any who would reduce plant taxonomy to objective formulae, equations and constants may well be in pursuit of a non-existent absolute. After the relativist revolution in physics, Bridgman (1938, p. 3) wrote: "Experience must be determined only by

experience. This practically means that we must give up the demand that all nature be embraced in a formula, either simple or complicated. It may perhaps turn out eventually that as a matter of fact nature can be embraced in a formula, but we must so organize our thinking as not to demand it as a necessity"—a caution as pertinent to the non-physical as to the physical sciences.

Summary

1. A quantitative study has been made of nine floral characters in six North American species of *Iris: I. macrosiphon*, *I. amabilis*, *I. Munzii*, *I. prismatica*, *I. versicolor*, and *I. virginica*. Data for the last two were taken from Anderson's (1928) measurements of living material. Data for the others were secured from well-prepared herbarium-specimens.

2. The method adopted was to compare the difference between the mean of a character in one species and the means of the same character in all the other species studied. The significance of the difference was tested by dividing the difference by its own standard error. Because of the margin of error introduced by utilizing dried material and by comparing data from dried material with living material in some instances, the threshold of significance for d/σ_d was somewhat arbitrarily raised from 3 to 6 or 7. The same process of comparison was also carried out for all standard deviations and coefficients of variation.

3. Of the three constants thus compared, the means gave the most significant results. Few instances of significant differences were found in standard deviations or coefficients of variation.

4. As a result of the study, Anderson's conclusions as to the distinctness of *I. versicolor* and *I. virginica* on quantitative grounds were fully confirmed. The separateness of *I. macrosiphon* and *I. amabilis* is considered doubtful. Despite the obvious specific distinctness of *I. prismatica*, the quantitative treatment of the floral characters studied offers almost nothing to differentiate it from *I. macrosiphon* and little more to distinguish it from *I. Munzii*.

5. Correlation coefficients for all character-combinations in *I. macrosiphon*, *I. amabilis*, *I Munzii*, and *I. prismatica* were worked out and tabulated with their approximate probabilities. The data afford further evidence in support of the non-separate status of *I. macrosiphon* and *I. amabilis*, but, in general, the results are less rewarding than the values of d/σ_d in the earlier portion of the work.

6. It is suggested that this mode of inquiry may be fruitful in many ways, but that quantitative methods are hardly likely to supersede all other treatments in plant taxonomy.

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STUDIES IN THE IRIDACEAE, VI.

Miscellaneous Novelties and Transfers

By

Robert C. Foster

During the past year or so, as a result of still-continuing monographic studies and the accumulation of miscellaneous materials sent for determination, a number of undescribed species have been detected. These are placed on record here.

Cypella mexicana Morton et Foster, spec. nov.

Bulbus ovoideus vel subglobosus, ad 2.5 cm. altus et 2 cm. latus, tunicae tenues, fragiles, atrobrunneae. Folia basalia 2–3, basi vaginantia, 6–38 cm. longa, 3–12 mm. lata, linearia vel ensiformia, glabra, acuta, plicata; folia caulina 1–2, foliis basalibus similia, 4–16 cm. longa, ad 2 cm. lata, folium superius reductum, plus minusve spathiforme. Caulis plerumque ramosus, raro simplex, rami saepe in axillis foliorum caulinorum laxe fasciculati, teres, glaber, axis primarius ramique spatharum bino 2-florata terminati. Spathae herbaceae, arcte convolutae, perinaequales, exterior 1.7–2.8 cm. longa, acuta, margines basim ca. 5 mm. coaliti, interior in axem supra exteriorem 5 mm. inserta, 2.1–4.5 cm. longa, apice truncata; pedicelli filiformes, anthesin spatham interiorem longitudine aequantes vel excedentes. Ovarium 3–5 mm. longum, ellipsoideum vel subclavatum, glabrum. Flores purpurei, tepala subaequalia; tepala exteriora ad 2.6 cm. longa et 1.3 cm. lata, obovato-spathulata, longe unguiculata, apice obtusa et minute purpureo-penicillata, unguis sublatus sursum dilatans, lamina basi maculis 2 ovalibus, densibus, glandulosis, pubescentibus ornata: tepala interiora unguiculata, unguis longus, sublatus, navicularis, sparse vel dense glanduloso-ciliatus, lamina plus minusve cuneata et valde deflexa, apice purpureo-penicillata et subretusa, basim glanduloso-ciliata. Filamenta libera vel basin coalita, ad 4–5 mm. longa; antherae 4–5 mm. longae, apice sub stigmata 1 mm. styli ramos adhaerentes. Stylus filiformis, ad 8 mm. longus; styli rami breves, ca. 1.5–2 mm. longi; styli cristae complanatae, ad 3.5 mm. longae, anguste oblongae, margo exterior subcrenulatus, apice obtuse rotundatae, petaloideae; stigmata plus minusve erecta, ca. 1 mm. longa, trilobata, lobus centralis quam laterales brevior. Capsula oblongo-ellipsoidea, ad 1.3 cm. longa; semina matura non visa.

MEXICO: Guerrero: Coyuca: El Pochote, in a marsh, July 19, 1934, *Hinton et al.*, no. 6313 (G); Montes de Oca: Petatlan, 50 m. alt., June 15, 1937, *Hinton et al.*, no. 10322 (type, US; isotypes G, NY, MBG); Mina: Anonas, in wet sand, 300 m. alt., July 27, 1936, *Hinton et al.*, no. 9163

(G, US). MICHOACÁN: Coalcomán: Villa Victoria, on a grassy hill, 700 m. alt., July 11, 1939, *Hinton et al.*, no. 13907 (G, NY, MBG).

This differs from *C. Rosei* R. C. Foster in its more intricate branching, somewhat smaller flowers of a much deeper purple, and in having style-arms, although short, definitely present.

Cypella Hauthalii (O. Ktze.), comb. nov.
Alophia Hauthalii O. Ktze. Rev. Gen. **3** (2): 304 (1898).

Study of the type of *Alophia Hauthalii*, *Hauthal*, no. 9, shows that without doubt it should be transferred to *Cypella*. Kuntze's description of the style as "apice breviter trilobatus lobis angustis oblongis obtusis" is incorrect. The style is about 1.5 cm. long, from base to stigma, enlarged upward, the style-arms apparently obsolete, the style-crests rather large, about 6–7 mm. long, linear-falcate, and acute. Better-preserved material is necessary to show whether or not the style-arms are actually obsolete. In any case, since the stigmas are transverse, at the base of style-crests, rather than apical, this plant is clearly a *Cypella*, not an *Alophia*.

Cardenanthus longitubus, spec. nov.

Bulbus ovoideus, ad 1.5 cm. altus, 1 cm. latus, tunicae tenues, atrobrunneae. Folia basalia plura, exteriora reducta, cataphylla ventricosa, interiora 3–4 longe vaginantia, laminae valde falcatae, glabrae, acutae, ad 10 cm. longae, 1 mm. latae, nervus primarius marginesque incrassati. Caulis plerumque subterraneus, simplex, teres, glaber, ad 3 cm. longus. Spathae aequales vel subaequales, exterior ad 2.2 cm. longa, abrupte acuminata, interior aliquando brevior, obtusa, 1–2-fl. Pedicelli filiformes, glabri, ad 6 mm. longi. Ovarium anguste ellipsoideum, glabrum, trigonum, 6 mm. longum. Flores pallide purpurei, nonnunquam atrostriati; perianthii tubus ad 7–8 mm. longus, anguste cylindricus, apice abrupte ampliatus; tepala exteriora longe unguiculata, obovata, ad 1.5 cm. longa, lamina subacuta ad 6 mm. lata; tepala interiora linearia vel anguste lineari-oblanceolata, acuta, ad 6 mm. longa, ca. 1 mm. lata, supra basin 1.5 mm. tumescentia. Staminum columna 5 mm. longa; antherae lineares, 4–5 mm. longae. Stylus ad 1.4 cm. longus; styli rami 1 mm. longi, 0.5 mm. bifidi. Capsula seminaque non visa.

BOLIVIA: LA PAZ: Pacajes: Rosario, 12,500 ft. alt., Jan. 13, 1921, *Mrs. R. S. Shepard*, no. 235 (TYPE, G; isotype, US).

This interesting little species, the second described from the collections of Mrs. Shepard, is at once distinguished by the longest perianth-tube and the longest style in the genus. According to the collector, it grows in wet sandy soil.

Cardenanthus peruvianus, spec. nov.

Bulbus ovoideus, ad 2 cm. altus, 1.5 cm. latus, tunicae tenues, atro-brunneae. Folia basalia 1–2, ad 28 cm. longa, 0.5–1.5 mm. lata, glabra, plicata, peracuta; folia caulina 1–2, ad 25 cm. longa, 1.75 mm. lata, spathas subtendentia. Caulis plerumque subterraneus, simplex, 2.5–4 cm. longus. Spathae subaequales, vel exterior longior, ad 3 cm. longae, obtusae, 1–2-fl.; pedicelli ad 7 mm. longi, glabri. Flores pallide violacei, atromaculati, perianthii tubus 4 mm. longus; tepala exteriora ad 1.8 cm. longa, 8 mm. lata, obovato-spathulata, subobtusa; tepala interiora ad 8 mm. longa, 1.5 mm. lata, oblanceolata, acuta, unguis brevis, glanduloso-tumescens. Staminum columna ad 10 mm. longa; antherae 3–3.5 mm. longae. Stylus ad 1.1 cm. longus; styli rami 2.5 mm. longi, bifidi 1.5 mm., lati, conduplicati. Capsula seminaque non visa.

PERU: Tarata: Candarave, 2900–3000 m. lat., Mar. 11–13, 1925, *Weberbauer*, no. 7387 (type, F).

Although this species is undoubtedly close to *C. Shepardae* R. C. Foster, it can be distinguished by its longer style and staminal column, broader outer tepals, and by the less bifid style-arms. According to the collector, it grows in open shrubbery.

Cardenanthus Vargasii, spec. nov.

Bulbus parvus, plus minusve globosus, ca. 1 cm. diam., tunicae tenues, membranaceae, brunneae, sursum in collum prolongatae. Folia basalia plura, basi longe vaginantia, laminae supra vaginas valde reflexae, ad 6 cm. longae, 2 mm. latae, plicatae, lanceolato-lineares, acutae, glabrae. Caulis plerumque subterraneus, simplex, ad 1.5 cm. longus, folia caulina absentia. Spathae subaequales, ad 1.8 cm. longae, acutae, vel interior subobtusa, 1- (raro 2-) fl., flores breve pedicellati. Ovarium oblongo-ellipsoideum, glabrum, ad 5 mm. longum. Flores albi, violaceo-lineati, perianthii tubus ad 1.5–2 mm. longus; tepala exteriora spathulata, ad 1.2 cm. longa, lamina 6 mm. lata, apice obtusa, retusa vel crenulata; tepala interiora unguiculata, unguis 2 mm. longus, non glanduloso-tumescens, lamina obovato-spathulata, 6 mm. longa, 3 mm. lata, obtusa. Filamenta tota coalita, tubus 4 mm. longus; antherae 2.3 mm. longae. Stylus 6 mm. longus; styli rami 1.5 mm. longi, paene ad basin bifidi, lati, conduplicati, cum costa interna centrale et tuberculo minuto ad sinum secondarium. Capsula seminaque non visa.

PERÚ: Puno: Carabaya: pampa de Lacka, Macusani, 4360 m. alt., Feb. 15, 1948, *Vargas* (*leg. P. E.*), no. 7135 (type, G).

This species differs from others in the genus in having very broad inner tepals and no cauline leaves. The presence of the small tubercles at the secondary sinuses of the style, so characteristic of the *Tigridia* group of genera, has not been noted in other species, but this may be due to the excellent preparation

and freshness of Dr. Vargas's material, which I received less than a month after its collection.

Mastigostyla Cabrerae, spec. nov.

Bulbus ovoideus, ad 2.5 cm. altus, 1.5 cm. latus, tunicae exteriores tenues, atrobrunneae. Caulis plerumque subterraneus, 3–7 cm. longus, simplex. Folia basalia ad vaginas brunneas valde reducta, raro unum productum, filiforme, acutum, ad 10 cm. longum, 0.5 mm. latum; folia caulina 2, spathas subtendentia, inferius 12–22 cm. longum, 2 mm. latum, lineare, longe attenuatum, acutum, glabrum, superius simile, sed brevius, ad 6 cm. longum. Spathae subaequales vel exterior longior, 2.5–3 cm. longae, exterior acuminata, obtusa, interior suboblonga, apice lata, obtusa, 1–2-fl. Ovarium oblongo-ellipsoideum, glabrum, 7 mm. longum. Flores lilacini, obscure maculati; tepala exteriora obovato-spathulata, ad 2 cm. longa, 5 mm. lata, longe unguiculata, apice rotundata; tepala interiora oblanceolata, 8 mm. longa, 1 mm. lata, unguis basi glanduloso-tumescens. Staminum columna 8 mm. longa; antherae lineares, 4 mm. longae. Stylus columnam longitudine aequans; styli rami ca. 3 mm. longi, bifidi ca. 1.5 mm., styli cristae multo reductae, ca. 0.5 mm. longae. Capsula seminaque non visa.

ARGENTINA: SALTA: San Antonio de los Cobres, Jan. 29, 1944, *A. L. Cabrera,* no. 8255 (TYPE, G).

It gives me much pleasure to name this species for its collector, the distinguished Argentine botanist, Dr. Angel L. Cabrera, who has added many rare and interesting plants to the collections of the Gray Herbarium.

The outstanding characteristic of the style of *M. Cabrerae* is the great reduction of the style-crests. This not simply because of the relatively small size of the flower, for other species, such as *M. brevicaulis*, have flowers of about the same size, but with much longer style-crests.

Mastigostyla peruviana, spec. nov.

Bulbus ovoideus, ad 2 cm. altus, 1.5 cm. latus, tunicae laeves, atrobrunneae vel nigrobrunneae. Folia basalia 1–2, 8–19 cm. longa, 1–3 mm. lata, linearia, acuta, glabra; folium caulinum 1, inflorescentiam excedens, 6–12 cm. longum, ad 2 mm. latum. Caulis simplex, teres, glaber, 2–9 cm. longus. Spathae subaequales, 3 cm. longae, non ventricosae, 2-fl.; pedicelli ad 2.5 cm. longi. Ovarium obovoideum, 8 mm. longum, glabrum. Flores caerulei; tepala exteriora ca. 2.2 cm. longa, 6–7 mm. lata, longe unguiculata, lamina oblonga, apice obtuse rotundata; tepala interiora 8–9 mm. longa, 2 mm. lata, anguste elliptica, acuta, unguis ad basin tumescens. Filamenta coalita 9 mm., libera 1 mm.; antherae 5 mm. longae. Stylus 1 cm. longus; styli rami 4 mm. longi, 2 mm. bifidi; styli cristae flagelliformes, ca. 6 mm. longae. Capsula seminaque non visa.

PERÚ: Apurimac: Andahuaylas: quebrada 2 km. east of Andahuaylas, among grass, sand and clay, 3050 m. alt., Feb. 23, 1939, *Stork & Horton*, no. 10726 (type, F; isotype, Univ. Calif.).

In its flagelliform style-crests, *M. peruviana* comes closest to *M. cyrtophylla* Johnst., but differs in its small size, smaller flowers, unbranched stem and non-ventricose spathes. From the dwarf *M. Hoppii*, the other Peruvian species, it can easily be distinguished by its marked caulescent habit and by the fact that its single cauline leaf does not immediately subtend the spathes. In addition, the style-crests of *M. peruviana* are very nearly as long as the style-arm and style-crest of *M. Hoppii*.

Mastigostyla Joergensenii, spec. nov.

Bulbus parvus, ovoideus, ad 2 cm. altus, 9–10 mm. latus, tunicae membranaceae, brunneae. Folia basalia plerumque reducta, 1 productum, ad 28 cm. longum, 1–2 mm. latum; folia caulina 2, ad 15 cm. longa, 2 mm. lata, linearia, acuta, glabra. Caulis 1–2-ramosus valde supra basim, teres, glaber, ad 22 cm. altus. Spathae herbaceae, subaequales vel exterior plus minusve brevior, ad 4.8 cm. longae, 3–4-fl., pedicelli filiformes, anthesin non exserti. Ovarium oblongo-ellipsoideum, ad 5 mm. longum, glabrum. Flores caerulei vel purpurei; tepala exteriora ad 3 cm. longa, longe unguiculata, lamina ca. 8 mm. lata, anguste obovata vel spathulata, obtusa; tepala interiora ad 7 mm. longa, 2 mm. lata, oblanceolata, subacuta, basi glanduloso-tumescentia. Filamenta fere tota coalita, 1.2 cm. longa; antherae lineares, 8 mm. longae. Stylus ca. 1.4 cm. longus; styli rami 5 mm. longi, sub stigmata 2 mm. bifidi; styli cristae ca. 4 mm. longae, subflagelliformes. Capsula seminaque non visa.

ARGENTINA: Catamarca: Andalgalá, no further data available, *Jörgensen* (type, US, no. 921640). La Rioja: Chilecito: Sierra de Famatina, camino a La Mejicana, 2550 m. alt., Feb. 5, 1927, *Parodi*, no. 8012 (G).

In size, this species is closest to *M. Cardenasii*, but it differs in being branched well above the base, in wider leaves, narrower outer tepals, and more or less flagelliform style-crests.

Rigidella Macbridei, spec. nov.

Bulbus ovoideus, ad 3 cm. altus, 1.5 cm. latus, tunicae brunneae. Folia basalia 1–2, ad basin longe vaginantia, ad 30 cm. longa, 2–6 (raro 8) mm. lata, lanceolato-linearia, glabra, acuta; folia caulina 1–2, longe vaginantia, lamina reducta, 6–14 cm. longa. Caulis simplex, raro ramosus, teres, glaber, 28–45 cm. longus. Spathae inaequales, exterior interior brevior, exterior acuta, 3–5 cm. longa, interior 4.5–5.5 cm. longa, obtusa, 2-fl.; pedicelli anthesin spatham interiorem longitudine aequantes, vel breviores. Ovarium ca. 1 cm. longum, oblongo-clavatum, glabrum. Flos aurantiacus, plus minusve nigromaculatus, tepala inaequalia; tepala

exteriora patentia, obovata vel late ovata, subacuta vel obtusa, ad 2.5 cm. longa, 1.5 cm. lata; tepala interiora erecta, in parte inferiore ovata, deinde abrupte truncato-contracta et longe lateque mucronata, ad 1.8 cm. longa, 8 mm. lata, lamina cum macula glandulosa, pubescente, triangulare ad basin. Filamenta coalita, 1.1 cm. longa; antherae 8 mm. longae, connectivum latum et tenue. Stylus 1.3 cm. longus; styli rami 4.5 mm. longi, bifidi paene ad basin, rami secondarii apice ca. 2 mm. lati. Capsula ad 3.5 cm. longa, anguste oblonga, obscure trigona; semina matura non visa.

PERÚ: JUNÍN: Rio Blanco, 4500 m. alt., Mar. 20–23, 1923, *J. F. Macbride*, no. 3046 (TYPE, US; isotypes, MBG, F, NY).

The assignment of this plant to *Rigidella* may be an error, since it gives that genus the uncomfortable range of three species in southern Mexico and Guatemala and this new one in Perú. Nevertheless, with its rather spreading outer tepals, the much smaller inner tepals erect and more or less appressed against the staminal column, and with its broad conduplicate secondary style-arms, it is difficult to assign it to any other genus.

Sphenostigma Goodspeedianum, spec. nov.

Bulbus ovoideus, 2–2.5 cm. altus, 1–1.5 cm. latus, tunicae exteriores lento-brunneae. Folium basale ad 50 cm. longum, 6 mm. latum, glabrum, subplicatum, acutum, lineare vel anguste ensiforme; folia caulina 2, ad 30 cm. longa et 8 mm. lata, superius reductum. Caulis raro simplex, plerumque 2-ramosus, teres, glaber, ad 40 cm. altus. Spathae 2–4-fl., glabrae, exterior acuta, interior parum longior, obtusa, ad 3.5 cm. longa; pedicelli glabri, anthesin non exserti. Ovarium glabrum, anguste oblongo-ellipsoideum, ad 6 mm. longum. Flores lutei; tepala exteriora late spathulata, ad 2.3 cm. longa, ca. 1.5 cm. lata, obtusa, intus pars inferior subpapilloso-puberula; tepala interiora oblanceolata, ad 8 mm. longa, 2 mm. lata, acuta vel breve mucronulata. Filamenta coalita, 3 mm. longa; antherae oblongae, acutae, 4 mm. longae. Stylus 7 mm. longus; styli rami paene obsoleti, lobi stigmatosi semi-lunati, 1.5–2 mm. alti. Capsula seminaque non visa.

BOLIVIA: COCHABAMBA: Mizque: between Chaguarani and Chioma silver mines, among stones under bushes, in dry sandy loam, 3200 m. alt., Apr. 1, 1939, *Eyerdam*, no. 25092 (TYPE, Univ. Calif.; isotype, F).

The new species, named for the director of the expedition on which it was collected, differs from the other known Bolivian species in its yellow, not blue, flowers. From *S. boliviense* Baker it differs further in the great disparity of the outer and inner series of tepals, and in the lack of lateral appendages on the stigmatic lobes, although it resembles *S. boliviense* in the united stamen-filaments. From *S. Mandonii* and its variety

it differs in the united filaments and in oblanceolate rather than cuneate inner tepals, these not long-apiculate, but very shortly mucronulate at best. There are no bulbils in the axils of the cauline leaves.

Sisyrinchium Rambonis, spec. nov.

Planta annua, pertenuis, caules primarii filiformes, decumbentes, substoloniformes, ad nodos radices saepius prehendentes, caules secondarii ad 7 cm. longi, glabri, filiformes, subancipiti. Folia saepius plura ad nodos, ad 7 cm. longa et 0.5 mm. lata, filiformia, glabra, acuta. Spathae terminales, glabrae, inaequales (raro subaequales), exterior ad 8 mm. longa, acuminata, acuta, margines pallidiores, interior ad 5 mm. longa, acuta, margines luteo-hyalini, 2–3-fl., pedicelli filiformes, glabri, anthesin suberecti, deinde recurvati. Ovarium subglobosum, ad 0.6 mm. diametro, glabrum. Flores lutei, tepala subaequalia, ad 4 mm. longa, ca. 1 mm. lata, oblanceolata vel anguste obovata, mucronulata, extus et intus ad basin sparse glanduloso-puberula. Filamenta coalita, ad 1.2 mm. longa, ad basin sparse glanduloso-villosa, pars superior nuda; antherae oblongae vel subquadratae, ad 0.6 mm. longae. Stylus antheras non excedens; styli rami minuti. Capsula subglobosa vel subpyriformis, obscure trigona, glabra, ad 3.2 mm. alta; semina ad 0.8 mm. longa, subglobosa vel angulata, foveolata, fovea micropylaris subprominens.

BRAZIL: Porto Alegre: Cambara, in paludosis fluitans, Jan. 26, 1949, *B. Rambo*, no. 36606 (type, G). Paraná: Curitiba, Feb. 11, 1903, *Dusén* (G).

This minute species, apparently an occupant of damp or even very wet habitats, usually has decumbent stems which root at the nodes, producing what look like basal fans of leaves and the true flowering stems. On the Dusén specimens cited, the spathes are more nearly equal than is true of the numerous specimens which comprise the type. It is clearly related to both *S. minus* Engelm. & Gray and *S. minutiflorum* Klatt.

A COLLECTION OF PTERIDOPHYTES FROM THE DOMINICAN REPUBLIC

By Richard A. Howard

The vegetation of the islands of the Caribbean has been collected and studied by a host of workers who ultimately recognize in it diverse and difficult problems of speciation and plant distribution. The number of species in each island is high and endemic species have been reported by Urban as representing as much as 43% of the total flora in some islands. In spite of the great number of collectors who have worked in the Caribbean, many critical areas remain to be studied, many genera and many families are poorly known, and the relationships and distribution of the species or of the total flora still present unsolved problems. The much needed flora of the Caribbean islands still awaits a great amount of work.

Perhaps the most important single island in any consideration of the vegetation of the Caribbean area is the island of Hispaniola, occupied by the countries of the Dominican Republic and the Republic of Haiti. Urban, studying the collections of such early workers as Plumier, Türckheim, Eggers, Abbott, Buch, & Fuertes, published numerous papers on the flora of Hispaniola in the series Symbolae Antillanae. His work culminated in the Flora Domingensis in volume eight and in the Pteridophyta Domingensia in volume nine. It was during the process of this study that Urban suggested to Ekman that he visit and collect in Hispaniola. Urban's treatments of the Hispaniolan vegetation were scarcely finished before the critical collecting and field notes of Ekman made those works obsolete. There then followed the series Plantae Haitienses et Domingenses Novae vel Rariores, by Urban and collaborators, in which were published new species and records and many critical notes based on the Ekman collections. Thus, at the time of Urban's death, his Flora Domingensis was out of date and scarcely of more than reference value due to the large number of new species described in separate papers and unincorporated in a flora.

The Dominican botanist R. N. Moscoso, sensing the need for a complete flora incorporating the known distribution of various species described in the Hispaniolan vegetation, began the compilation of references designed to bring into one publication all of the published records of plants from the island of Hispaniola. Moscoso's work appeared in 1943 as Catalogus Florae Domin-

gensis and has proven to be an excellent reference manual for workers on the vegetation of that island. However, Moscoso's work is still but a catalogue of the species, and the basic work of analyzing Urban's numerous species and writing a flora complete with descriptions and keys still remains to be done. It will not be a simple nor an easy task, as a glance at Moscoso's catalogue will show. One hundred species are reported in the genus *Pilea*, thirty-three species in *Calyptranthes*, sixty-two species in *Eugenia*, and sixty-four in *Miconia*, to mention only a few of the difficult genera of the area.

Moscoso's catalogue is entitled "Part I, Spermatophyta." It is hoped that the second part dealing with the Pteridophytes will be published soon and will bring together the literature and references for that group of plants.

It is unfortunate that Christensen did not realize the need for information on distribution when he published the paper entitled "The collection of Pteridophytes made in Hispaniola by E. K. Ekman, 1917 and 1924–30." (Kgl. Sv. Vetenskapsakad. Handl. 3rd series, **16**(2): 1–93. 1937.) Christensen reconsidered all the pteridophyte records included by Urban in the latter's Pteridophyta Domingensia (Symbol. Antill. 9: 273–397. 1925), and brought the concepts and the nomenclature up to date. However, he did not repeat the distribution records given by Urban but cited only those collections made by Ekman. Urban recognized 450 species in 1925; Christensen recorded numerous additional species, raising the total number to 645 species of Pteridophytes in Hispaniola. This is in contrast to 285 species of Pteridophytes in Maxon's treatment of the Pteridophyta in Flora of Puerto Rico and the Virgin Islands; 500 species for Jamaica (Maxon, Report Smithsonian Institution, 1920), and 366 species listed by Grisebach for the British Islands.

Many of the species in the large and diverse pteridophyte flora listed by Christensen are based on single collections or limited isolated records. It is my feeling that while the number of taxonomic entities may be nearly correct, the indicated isolation and local occurrence of many of these species in Hispaniola is not sound and that further exploration is needed to determine the true ranges. The island of Hispaniola has four mountain chains running diagonally across it. The land ranges in altitude from 150 feet below sea level at Lake Enriquillo to 10,300 feet at Pico Trujillo. Arid desert areas exist on the north and south coasts, and lush wet rain-forests in the mountainous areas. Roads are few and travel is difficult in many areas.

Large areas have not been explored from the botanical point of view, while others have been visited and revisited until the collections from a few areas far outweigh the representation from other larger areas.

In 1946 my wife and I collected in the Dominican Republic, making a special effort to fill in the gaps between the classic areas of other collectors. We visited briefly the Barahona peninsula, between the town of Enriquillo where Fuertes lived for a time and the town of Pedernales on the Haitian border, practically unknown territory, botanically as well as geographically. We also made a special effort to investigate the southern slopes of the Cordillera Central, particularly north of the town of San Juan de la Maguana. These areas were collected to determine in part the eastern extension of species from the Massif de la Selle in Haiti and the western extension of species previously reported from Constanza and Valle Nuevo. It is clear from the collections made in the latter area, e. g. Sabana Nueva, Piedra del Aguacate and Rio del Oro, that the species previously considered as localized in Valle Nuevo are actually wide-spread through the central range of mountains, and that additional collections and reports are necessary to complete our understanding of the distribution of Hispaniolan plants.

The following list of a collection of pteridophytes made in the Dominican Republic is published with the hope that other similar lists by recent collectors in the Caribbean area will also be published, to facilitate the task before students of the Caribbean flora, that is, the eventual compilation of a manual of the area.

The collections cited below were made by R. A. and E. S. Howard, from Aug. into Nov. 1946. Our work was sponsored in part by gifts from the Society of Fellows and the Arnold Arboretum of Harvard University. The work would not have been possible without the cooperation of the government of the Dominican Republic, and my wife and I are grateful for the support and assistance we received throughout our trip. A companion on many of our trips was Dr. Miquel Canela, whose assistance and companionship we gratefully acknowledge.

I wish to acknowledge my appreciation to Mr. Alfred Copp and other members of a field party of the Aluminum Company of America, for the opportunity of visiting the mountainous terrain north of the town of Pedernales, at the western edge of Barahona peninsula. From Pedernales we travelled by mule on the Pedernales-Duverge trail, through Bucan Polo to the crest area at Aceitial. The geology of this area has been reported in the

Geological Survey Bulletin 953–C, published in 1947, and entitled "Aluminous Lateritic Soil of the Sierra de Bahoruco Area, Dominican Republic, W. I." A report on the vegetation of this limestone area, and particularly the savannah area, is being prepared and will be published later. Through the kindness of Mr. George Hamor of the Barahona Sugar Company, who not only supplied transportation, bed and board, but made a most delightful and stimulating companion, we were able to spend several days in the mountains north and slightly west of Barahona. This area, on the road from Cabral to Polo, is now the site of a new coffee plantation. The mountain tops are covered with either a pine forest or a hardwood forest. Extensive collections were made in the area known as Montiada Nueva (Bull. Torrey Club. **75**: 335–357. 1948). However, much work remains to be done in this fascinating region.

With mules supplied by the Dominican Government at San Juan, we were able to follow the little used trail north to Rio Arriba and through the mountains towards San Jose de las Matas. Ekman followed a portion of this trail and, following in his footsteps, we found the collecting excellent along the Rio Limon at Rio Arriba del Norte (Through the Garden Gate, vol. 3, No. 2, 1948), along the Rio del Oro, at Piedra del Aguacate on the Rio del Oro, and at the crest in the interesting grassy swamps of Sabana Nueva and Sabana Bonita, in the Lomas de la Mediania region. The vegetation of this area proved to be that of the classic area of Valle Nuevo, near Constanza. The natives report that farther to the west in this same area are other similar savannahs, which certainly need visiting and study before the distribution of the high mountain flora could be completely mapped.

During the process of identifying the collections cited in this paper, the author called upon the assistance of the late Mr. C. A. Weatherby. He gave generously of his time and knowledge in the determination of this collection and I will be forever grateful for his interest in my work on the Caribbean flora. A few specimens could not be accurately determined in the collections at the Gray Herbarium or the New York Botanical Garden, and these were sent to Mr. C. V. Morton at Washington. His assistance in identifying these critical specimens is greatly appreciated.

Azollaceae

Azolla caroliniana Willd. San Juan: San Juan, 8790. Floating plant in roadside ditches, especially abundant near Rio Mijo.

Ceratopteridaceae

Ceratopteris deltoidea Benedict, Higuey: Higuey, 9838. Solitary, large plant floating in the center of a pond crowded with *Cyperus*, *Pistia*, *Eichornia* and *Marsilea*.

Cyatheaceae

Cyathea Abbottii Maxon, Barahona: Montiada Nueva, 8545. Small tree fern of dense wooded areas. Trunks usually around 4′ tall.

Cyathea Grevilleana Mart. Barahona: Montiada Nueva, 8483. A 25′ tree fern with a spiny trunk, growing in dense woods.

Cyathea Hieronymi Brause, San Juan: Piedra del Aguacate, 9441. 20′ tree fern on dense forested hillsides.

Cyathea pubescens Mett. Barahona: Montiada Nueva, 8563. Small tree fern with trunks reaching 3′ in height.

Lophosoria quadripinnata (Gmel.) C. Chr. (*Alsophila quadripinnata* (Gmel.) C. Chr.) San Juan: Sabana Nueva, 9164; Piedra del Aguacate, 9393. A common fern along streams at higher altitudes. Fronds become 12′ long in some specimens.

Gleicheniaceae

Dicranopteris bifida (Willd.) Maxon, Barahona: Montiada Nueva, 8553; San Juan; Piedra del Aguacate, 9346. Both of these collections were made on open hillside where the plants had ample opportunity to spread. The individual plants seemed to be of indeterminate length and cascaded over other shrubs covering a hillside. Both of these collections consist of plants with woolly tomentose rachises, terminal shoots and under surfaces of the ultimate segments. The material is distinct from any other I have seen and may well represent a new taxonomic entity.

Hymenophyllaceae

Hymenophyllum axillare Sw. San Juan: Rio del Oro, 8991. Terrestrial on bank of the arroyo; Piedra del Aguacate, 9376. Epiphytic plant on shrubs along the creek.

Hymenophyllum fucoides Sw. San Juan: Sabana Nueva, 9009. Scattered plants of this species were growing in a solid bank of *Sphagnum meridense* on a wet dripping hillside.

Trichomanes angustatum Carm. (*T. tenerum* Spreng.) Barahona: Montiada Nueva, 8618. The present collection was made of epiphytic plants growing on hardwood shrubs. This species is usually found on trunks of tree ferns.

Marattiaceae

Marattia Kaulfussii J. Sm. Barahona: Montiada Nueva, 8557. Short tree ferns in dense wet woods. Trunks to 3′ tall.

Marsileaceae

Marsilea Berteroi A. Braun, Monte Cristi: Monte Cristi, 9593. An infrequent plant in roadside ditches, found only in areas of little standing water. This is the first record of this species from the Dominican Republic.

Marsilea polycarpa Hook. & Grev. Trujillo: Cuenca near Guerra, 9521. Trailing and floating plants at the edge of small ponds. Seibo: Higuey, 9840. Floating plants in protected lagoons. Usually associated with *Pistia*.

Ophioglossaceae

Botrychium cicutarium (Sw.) Sw. San Juan: Piedra del Aguacate, 9361. Common plant in hardwood thickets in ravines at higher altitudes.

Botrychium Jenmanii Underw. San Juan: Sabana Nueva, 9138; Piedra del Aguacate, 9338. Occasional plant of riverbanks or open hillsides in pine woods.

Ophioglossum nudicaule L. var. *tenerum* (Mett.) Clausen, Trujillo: Cuenca near Guerra, 9525. A single plant of this species was found at the edge of a small pond near Cuenca. A second trip to the same area found the locality completely submerged and the pond remained enlarged during the following week. *O. ypanemense* of Christensen is synonymous with this entity, according to Clausen (Mem. Torr. Bot. Club, **19** (2): 146–8. 1938).

Ophioglossum petiolatum Hook. San Juan: Sabana Nueva, 9061. A common plant, although few of the specimens were fertile, growing in wet grassy savannahs, usually under a growth of *Lycopodium*.

Ophioglossum palmatum L. Barahona: Montiada Nueva, 8569. Epiphytic.

Polypodiaceae

Adiantopsis Reesii (Jenm.) C. Chr. Elias Piña: Hondo Valle, 8757. Growing on limestone rock near the cave. This is the first record of this species from the Dominican Republic.

Adiantum concinnum H. & B. ex Willd. San Juan: Rio Arriba del Norte, 8881. Terrestrial in the arroyo.

Adiantum cristatum L. Elias Piña: Hondo Valle, 8746, 8772; Juan Santiago, 9254. Terrestrial along the banks of streams.

Adiantum fragile Sw. San Juan: Rio Arriba del Norte, 8852. Terrestrial riverbank fern.

Adiantum melanoleucum Willd. Barahona: Barahona, 8300. Terrestrial on limestone rock.

Adiantum latifolium Lam. Higuey: Higuey, 9724. Epiphyte on the buttress roots of large trees.

Adiantum petiolatum Desv. Higuey: Higuey, 9733. Terrestrial.

Anogramma chaerophylla (Desv.) Link, San Juan: Sabana Nueva, 9117, 9151. An annual fern growing in abundance on a wet dripping rock face in pine woods.

Antrophyum Urbani Brause, Barahona: Montiada Nueva, 8478, 8575. Epiphytic fern in dense woods. Only other record of this species from the Dominican Republic is the collection of Fuertes, 1497B, also from near Barahona.

Asplenium alatum H. & B. Barahona: Montiada Nueva, 8481. Terrestrial.

Asplenium cristatum Lam. San Juan: Juan Santiago, 9261; Piedra del Aguacate, 9357. Epiphytic fern on large trees in dense hardwood thickets.

Asplenium dimidiatum Sw. San Juan: Rio Arriba del Norte, 8817. Terrestrial on riverbank.

Asplenium formosum Willd. San Juan: Rio Arriba del Norte, 8816, 8845, 8895. Terrestrial fern on riverbank.

Asplenium harpeodes Kunze, San Juan: Piedra del Aguacate, 9402. Epiphyte, in dense woods.

Asplenium monanthes L. San Juan: Piedra del Aguacate, 9379. Growing on rocks in the river.

Asplenium praemorsum Sw. Elias Piña: Hondo Valle, 8673; San Juan: Sabana Nueva, 9108; Juan Santiago, 9200. Growing as an epiphyte on tree trunks or on rocks in the river.

Asplenium praemorsum Sw. var. Elias Piña: Hondo Valle, 8773. This collection has narrow bipinnatifid leaves and, in the field, is quite distinct from the material of *A. praemorsum* cited above. It may agree with the material collected by Ekman, 11760, and cited by Christensen as A. sp. dub. (l. c. 55), which I have not seen.

Asplenium radicans L. (*Asplenium flabellulatum* Kze.) Barahona: Montiada Nueva, 8487.

Asplenium radicans L. (*Asplenium Karstenianum* Klotzsch) Barahona: Montiada Nueva, 8561.

Asplenium radicans L. (*Asplenium cyrtopteron* Kunze) Barahona: Montiada Nueva, 8486.

The three collections cited above were made in a dense forest on a hilltop at 4000′. The type of frond cutting represented by collection No. 8487, often called *A. flabellulatum*, was the most common. Collection No. 8561 had the pinnae scarcely lobed, with the lower pinnae slightly auriculate. This collection agrees most closely with the majority of material called *A. radicans* from the continent of S. America. Actually, all intermediate stages of cutting could be found in the field, and it appears that *A. flabellulatum*, *A. Karstenianum*, and *A. cyrtopteron*, are only varieties of *A. radicans*.

Asplenium resiliens Kunze, Barahona: Aceitial, north of Pedernales, 8155, 8197. These collections were made in a limestone ravine in pine woods at 4200′.

Asplenium sarcodes Maxon, Barahona: Montiada Nueva, 8488, 8535. A terrestrial fern in dense thickets. This is the first record of this species from Hispaniola. It is already known from Porto Rico and Cuba.

Asplenium serra Langsd. & Fisch. San Juan: Piedra del Aguacate, 9359. Barahona: Montiada Nueva, 8495, 8541. Epiphytic ferns in hardwood thickets.

Asplenium Sintenisii Hieron. San Juan: Piedra del Aguacate, 9358. Barahona: Montiada Nueva, 8598. Terrestrial plant in hardwood thickets.

Asplenium theciferum (HBK) Mett. San Juan: Piedra del Aguacate, 9370. Epiphyte on tree ferns.

Blechnum occidentale L. San Juan: Juan Santiago, 9291, Piedra del Aguacate, 9354. Barahona: Montiada Nueva, 8494, 8530. Terrestrial plant of hardwood areas.

Blechnum polypodioides (Sw.) Kuhn, Barahona: Montiada Nueva, 8489. Climbing epiphytic fern with terminal fertile fronds.

Blechnum Tuerckheimii Brause, San Juan: Piedra del Aguacate, 9396. Terrestrial plant of marshy areas, with separate fertile fronds.

Cheilanthes lendigera (Cav.) Sw. San Juan: Sabana Nueva, 9115. Found only on one large wet dripping rock, where Ekman also collected it.

Cheilanthes microphylla Sw. Monte Cristi: Monti Cristi, 9578. Terrestrial on an elevated coral reef south of town.

Cheilanthes myriophylla Desv. San Juan: Rio Arriba del Norte, 8818. Terrestrial.

Cheilanthes notholaenoides (Desv.) Maxon (*C. micromera* Link), Barahona: Aceitial north of Pedernales, 8172, 8198. San Juan: Rio Arriba del Norte, 8846a. Terrestrial, usually in pine woods.

Cystopteris fragilis (L.) Bernh. San Juan: Sabana Nueva, 9112. A common and beautiful fern, growing on wet dripping cliff faces. Rhizomes extremely fragile.

Dennstaedtia ordinata (Klf.) Moore, San Juan: Piedra del Aguacate, 9394. Terrestrial plant at the edges of a marsh on a wet hillside. Simple fronds to 5′ long. Previously reported in the Dominican Republic from the Samana Peninsula.

Didymochlaena truncatula (Sw.) J. Sm. Barahona: Montiada Nueva, 8571. Terrestrial.

Diplazium aemulum Underw. & Maxon, Barahona: Montiada Nueva, 8601. Terrestrial plant. Christensen refers this species to the synonymy of *D. unilobum*. *D. aemulum* has a different characteristic denticulation of the pinnae, and the two plants have quite different aspects in the field.

Diplazium domingense Brause, Barahona: Montiada Nueva, 8562, 8576. Terrestrial. Both Christensen and Maxon refer this species to *D. centripetale* (Baker) Maxon. Again the aspect of this plant in the field seems quite different from that of *D. centripetale*. In addition, there is an abundance of scales on the stipes of *D. centripetale* and relatively few scales, located only at the base, on fronds of *D. domingense*.

Diplazium unilobum (Poir.) Hieron. San Juan: Piedra del Aguacate, 9355. Terrestrial in hardwood thickets.

Doryopteris pedata (L.) Fée, San Juan: Rio Arriba del Norte, 8819, 8897. Higuey: Higuey, 9729. The specimens from Rio Arriba were growing on rocks on a riverbank in a shaded location. The Higuey material came from a wet marshy hardwood thicket where the specimens were growing on shrubby hummocks.

Dryopteris asplenioides (Sw.) Kuntze, San Juan: Piedra del Aguacate, 9360. Terrestrial plants found only in river valleys.

Dryopteris domingensis (Spr.) Maxon (*D. guadalupensis* (Wikstr.) C. Chr.), San Juan: Juan Santiago, 9259. Plants of wet river bottoms.

Dryopteris imitata C. Chr. Barahona: Aceitial, north of Pedernales, 8168.

Previously reported from the north coast of Hispaniola, from areas near Port au Paix, Puerto Plata, and the Samana Peninsula.

Dryopteris normalis C. Chr. San Juan: El Cercado, 8670. Macoris: San Pedro de Macoris, 9477. A common fern of riverbanks, roadside cuts or the walls of limestone sinks. The rhizomes are securely fastened in the crevices and the plants are difficult to remove.

Dryopteris patula (Sw.) Underw. San Juan: Sabana Nueva, 9109, 9110, 9114. These three collections were made in the same area but from different conditions of exposure and environment. 9109 was collected in a wet dark cave formed by large boulders. The plants are of thin texture and very light in color. 9110 was collected in open pine woods where it was growing on top of boulders in a semi-arid habitat. The fronds of these plants were stiff and coriaceous. 9114 was collected on a wet dripping cliff face and the fronds were weak and soft. All of these plants have the numerous small shining glands characteristic of the species, and are quite distinct from the named varieties.

Dryopteris physematioides (Kuhn & Christ) C. Chr. San Juan: Sabana Nueva, 9159. A fern growing in running water or in the matted floating vegetation in the marshy areas.

Dryopteris reptans (Gmel.) C. Chr. Barahona: La Salinas, 8390a. A terrestrial plant growing on soil above the salt outcrop. Elias Piña: Hondo Valle, 8762. Terrestrial, in dense woods.

Dryopteris sancta (L.) Ktze. Barahona: Aceitial, north of Pedernales, 8176. Terrestrial plant on limestone soil in open pine woods. San Juan: Hondo Valle, 8775, 8778; San Juan: Juan Santiago, 9256. These three collections were all made on boulders in creek beds. The collection numbered 8778 was partially climbing and had a rhizome about 12″ long.

Dryopteris serra (Sw.) Ktze. Barahona: Aceital, north of Pedernales, 8161, 8171. San Juan: Hondo Valle, 8735. Terrestrial plants on dry banks or roadcuts.

Dryopteris Stübelii Hieron. San Juan: Piedra del Agucate, 9332. Stout plants of marshy areas on wet hillsides. Fronds to 4′ long. Young fronds with slimy glutinous scales. A first record from Hispaniola.

Dryopteris subtetragona (Link) Maxon, Higuey: Higuey, 9726. Terrestrial in hardwood thickets.

Elaphoglossum Fuertesii Brause, Barahona: Montiada Nueva, 8550. Epiphyte.

Elaphoglossum leptophyllum (Fée) Moore, San Juan: Sabana Nueva, 9093. A swamp plant growing in mixed vegetation in deep water.

Elaphoglossum muscosum (Sw.) Moore, San Juan: Piedra del Aguacate, 9002. Terrestrial plant on the top or sides of large rocks.

Elaphoglossum pallidum (Baker) C. Chr. San Juan: Piedra del Aguacate, 9378. Terrestrial plant of riverbanks.

Elaphoglossum piloselloides (Presl) Moore, San Juan: Sabana Nueva, 9038. Terrestrial fern growing on wet dripping rock face in deep shade. The sterile fronds are normally circinnate but the fertile fronds are briefly circinnate and conduplicate, opening to reveal the fertile surface densely

covered with sporangia. The species was collected by Ekman in the same locality.

Elaphoglossum revolutum (Liebm.) Moore, San Juan: Sabana Nueva, 9100. Growing on large boulders.

Elaphoglossum Sellowianum (Presl) Moore (*E. inaequalifolium* (Jenm.) C. Chr.), Barahona: Montiada Nueva, 8498. San Juan: Sabana Nueva, 9063. Terrestrial plant growing on large rocks.

Elaphoglossum tambillense (Hook.) Moore, San Juan: Sabana Nueva, 9111. Terrestrial fern growing on large rocks. Collected by Ekman in the same locality.

Hemionitis palmata L. Higuey: Higuey, 9716. Fern growing on old stump of tree in wet marsh.

Ithycaulon inaequale (Kze.) Copel. (*Saccoloma inaequale* (Kze.) Mett.) Barahona: Montiada Nueva, 8560. A tree fern of wet ravines. Trunks smooth, to 7′ tall.

Nephrolepis hirsutula (Forst.) Presl, Barahona: Montiada Nueva, 8473a. A well established terrestrial plant of roadsides, apparently escaped from cultivation.

Notholaena bonariensis (Willd.) C. Chr. San Juan: Sabana Nueva, 9172. Extremely abundant, attractive fern, growing on banks of arroyo.

Notholaena incana Presl (*Pellaea nivea* (Poir.) Prantl), San Juan: Sabana Nueva, 9113. Attractive fern of wet dripping cliff faces. A second locality in the Dominican Republic of a species ranging from the highlands of Central Mexico, southward to Guatemala. Known previously from Hispaniola by the single collection of Ekman, 13770, from Pico del Valle Nuevo.

Notholaena trichomanoides (L.) R. Br. Barahona: La Mina at La Salinas, 8393. A plant growing on pure or decomposed salt rock; Aceitial, north of Pedernales, 8167. Plant of limestone rocks. San Juan: Rio Arriba del Norte, 8815, 8854. Arid bank of arroyo.

Odontosoria aculeata (L.) J. Sm. Barahona: Aceitial, north of Pedernales, 8177. Plant of clear areas in pine woods at 4200′. San Juan: Sabana Nueva, 9145; Piedra del Aguacate, 9412.

Odontosoria uncinella (Kze.) Fée, Barahona: Montiada Nueva, 8551.

Pellaea ovata (Desv.) Weatherby (*P. flexuosa* (Kaulf.) Link), San Juan: Rio Arriba del Norte, 8823. A very attractive fern with tan stems and pale green fronds. Plant extremely fragile. Common on the very edge of the arroyo bank.

Pellaea ternifolia (Cav.) Link, San Juan: Sabana Nueva, 9137. A fern of unusual appearance with irridescent and brittle stems, growing in great abundance on a gravel, well drained bank of the Rio Sabana Nueva, in full exposure.

Pityrogramma calomelanos (L.) Link, Barahona: Montiada Nueva, 8475. Trujillo: Cuenca, 9956. Seibo: Higuey, 9710. These collections were made of plants growing on dry roadside banks.

Pityrogramma tartarea (Cav.) Maxon, Barahona: Montiada Nueva, 8474. Dry exposed roadside banks.

Plagiogyria semicordata (Presl) Christ, San Juan: Sabana Nueva, 9123. Plant of wet swampy places. Fertile fronds separate.

Polybotrya cervina (L.) Kaulf. Barahona: Montiada Nueva, 8538. Terrestrial plant with separate fertile and sterile fronds.

Polypodium angustifolium L. San Juan: Rio Arriba del Norte, 8838, 8937. Epiphytic, semi-climbing fern.

Polypodium angustifolium var. *amphostenon* (Kze.) Hieron. San Juan: Sabana Nueva, 9013. This wide-leafed variety was growing on rocks in the river, where it was flooded periodically. Its habit and habitat are quite in contrast to the species which usually grows as an epiphyte, with a climbing form on tree trunks.

Polypodium apiculatum Kze. Barahona: Montiada Nueva, 8565. Epiphyte.

Polypodium astrolepis Liebm. San Juan: Rio Arriba, 8827. Epiphyte.

Polypodium aureum (L.) var. *areolatum* H. & B. Barahona: Barahona, 8459; Montiada Nueva, 8532.

Polypodium crassifolium L. Barahona: Barahona, 8457; Montiada Nueva, 8537. Epiphyte.

Polypodium heterophyllum L. Barahona: Aceitial, north of Pedernales, 8263; Azua: Peralta, 9195; Rio Arriba del Norte, 8871. Epiphyte.

Polypodium lanceolatum L. Barahona: Montiada Nueva, 8435, 8531. San Juan: Sabana Nueva, 9029. Epiphyte.

Polypodium lasiopus Klotzsch, San Juan: Sabana Nueva, 9107. Found only on rocks.

Polypodium loriceum L. Barahona: Montiada Nueva, 8522, 8555. Epiphytic fern with characteristic bright green rhizomes.

Polypodium lycopodioides L. Barahona: Montiada Nueva, 8607. Higuey: Higuey, 9821. Epiphyte.

Polypodium pectinatum L. Barahona: Montiada Nueva, 8431. San Juan: Hondo Valle, 8753; Juan Santiago, 9288. Tree trunk epiphyte.

Polypodium piloselloides L. Higuey: Higuey, 9732. Epiphyte.

Polypodium polypodioides (L.) Watt, Higuey: Higuey, 9820. Epiphyte.

Polypodium squamatum L. Barahona: Barahona, 8460; Montiada Nueva, 8501, 8523. Epiphyte.

Polypodium thyssanolepis A. Braun, San Juan: Rio Arriba del Norte, 8833. Epiphyte.

Polypodium vulpinum Lindman, Barahona: Montiada Nueva, 8548. Epiphyte.

Polystichum adiantiforme (Forst.) J. Sm. Barahona: Barahona, 8463. Epiphyte.

Polystichum echinatum (Gmel.) C. Chr. Barahona: Aceitial, north of Pedernales, 8157, 8176. Elias Piña: Hondo Valle, 8764; San Juan: Juan Santiago, 9297. Terrestrial fern on limestone rocks, usually near streams.

Pteris longifolia L. Barahona: Montiada Nueva, 8585. Terrestrial fern on gravel roadbank.

Pteris longifolia var. *decrescens* C. Chr. Barahona: Aceitial, north of Pedernales, 8161. Terrestrial plant of pine woods on limestone soil.

The type of this variety was collected at Badeau on Massif du Selle. The present collection is an extension of the range eastward in the same chain, and is the first collection from the Dominican Republic.

Pteris podophylla Sw. San Juan: Piedra del Aguacate, 9397. These specimens were collected at the edges of a marsh formed at the foot of a wet dripping hillside. The palmately compound fronds stood 4′ tall. Fertile fronds are separate and were infrequent in a large stand of sterile fronds. This is the first record of the species from the Dominican Republic.

Pteridium aquilinum (L.) Kuhn var. *arachnoideum* (Kaulf.) Brade, San Juan: Sabana Nueva, 9163. A common fern forming dense stands on open pine hillsides at higher altitudes. Seems to form where the pine woods have been cut or destroyed by fire. The stands often become 8′ tall, with a definite canopy formed and a characteristic shade flora occurring below the canopy.

Pteridium aquilinum (L.) Kuhn var. *caudatum* (L.) Sadeb. Barahona: Aceitial, north of Pedernales, 8227; Barahona 8449; Elias Piña: Hondo Valle, 8684; San Juan: Rio Arriba del Norte, 8957. A more common variety found at lower altitudes but usually in the pine belt. Plants usually short and individuals partly separate, rarely forming dense or tall stands.

Rhipidopteris peltata (Sw.) Schott, Barahona: Montiada Nueva, 8542. Terrestrial or epiphytic on fallen and usually partially decayed logs, in wet dense areas of hardwood.

Sphenomeris clavata (L.) Maxon (*Stenoloma clavatum* (L.) Fée), Barahona: Aceitial, 8169. San Juan: Rio Arriba del Norte, 8949. The collection from Aceitial was made in a dry limestone ravine, on steep walls in shaded locations. The Rio Arriba collection was made in a shaded ravine but the plants grew in a large mass at water level.

Tectaria heracleifolia (Willd.) Underw. San Juan: Rio Arriba del Norte, 8907, 8941. Common fern growing on rocks in the river.

Trismeria trifoliata (L.) Diels, Elias Piña: Hondo Valle, 8725. A strikingly handsome fern, growing in coarse gravel along the edges of the river. Plants reached 4′ in height.

Vittaria filifolia Fée, Barahona: Montiada Nueva, 8507. Epiphyte.

Vittaria remota Fée, Barahona: Montiada Nueva, 8549. Epiphyte.

Schizaeaceae

Anemia adiantifolia (L.) Sw. Azua: Peralta, 9177; Elias Piña: Hondo Valle, 8687; San Juan: Juan Santiago, 9281. These three collections were made from plants growing on overhanging limestone rock; from occasional plants on the bank of a river; and from plants on a dry pine covered hilltop, respectively.

Anemia hirsuta (L.) Sw. San Juan: Rio Arriba del Norte, 8820.

Anemia phyllitidis (L.) Sw. Elias Piña: Hondo Valle, 8679, 8750. Terrestrial plants of riverbanks.

Anemia Underwoodiana Maxon, San Juan: Juan Santiago, 9255. This plant was very common on open hillsides, usually growing near cracks or small caves. Unfortunately, the plants seem to be preferred by the paper

wasps which build nests in great numbers on the ferns. It soon became a standard and wise procedure for collectors to approach this species with considerable caution.

Lygodium venustum Sw. Trujillo: Bayaguana, 9950. Uncommon plant of open grassy savannahs.

Equisetaceae

Equisetum giganteum L. San Juan: El Cercado, 8664; Elias Piña: Hondo Valle, 8690; San Juan: Sabana Nueva, 9096. While all three of these collections were made of plants growing in wet places, the plants themselves showed varied habits. The El Cercado specimens were growing along a river in dense shrubs. The plants approached 20′ in height. The Hondo Valle plants were in open areas, especially sandbars in the small creeks, and grew in dense masses usually 5–7′ tall. The Sabana Nueva plants were collected at an altitude of 6,500′ and only a few isolated plants were found in the open grassy marsh or savannah These plants rarely reached a height of 4′ and most specimens were 12–18″ tall.

Psilotaceae

Psilotum nudum (L.) Griseb. Elias Piña: Hondo Valle, 8763; San Juan: Rio Arriba del Norte, 8882. The plants from Hondo Valle were epiphytic on the bases of shrubs. The Rio Arriba material was collected from the leaf duff in an open flood plain near the river.

Lycopodiaceae

Lycopodium cernuum L. San Juan: Sabana Nueva, 9130. Hanging plant of eroded riverbank.

Lycopodium clavatum L. San Juan: Sabana Nueva, 9010. Growing in a mat of *Sphagnum meridense*, on a wet hillside.

Lycoposium complanatum L. var. *tropicum* Spring, San Juan: Sabana Nueva, 9064.

Lycopodium reflexum Lam. San Juan: Sabana Nueva, 9033. Trailing plant of open grassy swale.

Lycopodium taxifolium Sw. Barahona: Montiada Nueva, 8496, 8515. San Juan: Sabana Nueva, 9044; Piedra del Aguacate, 9371. Epiphytic hanging plants from trees or rocks.

Selaginellaceae

Selaginella Leonardii Schmidt, Barahona: Aceitial, north of Pedernales, 8173. A plant climbing on limestone walls of a ravine in pine woods at 4200′.

Selaginella Meyerhoffii Hieron. San Juan: Juan Santiago, 9213. Infrequent plant of creek banks.

Selaginella Plumieri Hieron. San Juan: Sabana Nueva, 9147. Plant of mossy cliff under a small waterfall; Piedra del Aguacate, 9325. Epiphytic on trunk of tree fern.

Selaginella stolonifera (Sw.) Spring, Azua: Peralta, 9176. Trujillo: Bayaguana, 9513. Extremely abundant plants covering sides of road cut and dominating ground cover below shrubs.

STUDIES ON SOME NORTH AMERICAN CRUCIFERAE

By Reed C. Rollins

The continued accumulation of materials of the Cruciferae for revisionary work has brought to light an unusual group of new entities. These provoke questions as to generic relationships within the family as well as species relationships within certain genera. Species in *Lesquerella*, *Physaria*, *Smelowskia*, and *Eutrema*, are dealt with in the paragraphs that follow.

Lesquerella

In his monograph of *Lesquerella*, Payson (1922) created section *Enantiocarpa* to accommodate plants with siliques strongly compressed at right angles to the replum. Three species, *L. lasiocarpa* of Texas and Mexico, *L. argentea* (as *L. Schaueriana*) of Mexico, and *L. frigida* of Venezuela, were included. In the other forty-nine species accepted, the siliques were either uncompressed or compressed parallel to the replum. Two undescribed species of *Lesquerella* from the mountains of Idaho and Wyoming, have siliques flattened at right angles to the replum and the question as to their natural relationships immediately arises. Following Payson, the new species would fall into section *Enantiocarpa*. However, it is quite apparent, from a comparative study of the new plants and other species of the genus, that they are more closely related to *L. occidentalis*, *L. diversifolia*, and *L. Cusickii*, than to any of the species of that section. The characteristics of growth-habit, pubescence, leaves, and flowers, in these new plants are quite similar to members of the *L. occidentalis* group of species. The one striking difference is in the flattening of the siliques. In the *L. occidentalis* group, the valves are somewhat flattened parallel to the replum on the margins and toward the apex. In the new plants, the valves are uniformly flattened at right angles to the replum, except for a keel produced on each side by the replum itself in one of the species, *L. carinata*. This difference is fundamental and reflects major modifications in orientation of the flower parts. A reexamination of the evidence supporting section *Enantiocarpa* will be required in any subsequent revision of *Lesquerella*. Following are descriptions of these new entities.

Lesquerella carinata Rollins, sp. nov.

Short-lived perennial; stellate-pubescent throughout with many-rayed stellae, rays forked near base or sometimes simple, usually somewhat

coherent towards their bases; caudex simple, thickened but not greatly so; stems several to many, decumbent, greatly exceeding basal leaves, unbranched, purplish, 5–15 cm. long; basal leaves tufted, entire, petiolate, silvery pubescent; blade elliptical to broadly obovate, 4–15 mm. long, 2–10 mm. broad, narrowing abruptly to a slender petiole; petiole 5–20 mm. long; terminal bud undeveloped; cauline leaves 2–5, petiolate, entire, 4–15 mm. long, blade oblanceolate to obovate; sepals oblong, pubescent, 4–6 mm. long, outer pair saccate, inner non-saccate; petals yellow, spatulate, 8–10 mm. long; fruiting raceme elongated; pedicels divaricate to ascending, straight to slightly sigmoid, 5–8 mm. long; siliques elliptical, rounded to more narrowly tapered at each end, strongly flattened at right angles to the replum, margins strongly flattened and the replum forming strong keels on each of the flattened sides, pubescent, 5–8 mm. long, 3–5 mm. wide; styles glabrous, 2–3 mm. long, stigmas capitate; locules with 5–7 ovules; replum obtuse to acute at apex, 5–8 mm. long, 2–3 mm. wide; funiculi slender, attached to septum near base; seeds brown, wingless, slightly longer than broad, somewhat flattened but remaining plump, ca. 2 mm. long; cotyledons accumbent. Fig. I. E–H.

Herba perennis undique indumento argenteo-stellato tecta; caulibus decumbentibus simplicibus 5–15 cm. longis; foliis radicalibus petiolatis ellipticis vel ovatis; foliis caulinis integris oblanceolatis vel ovatis 4–15 mm. longis; sepalis oblongis pubescentibus 4–6 mm. longis; petalis luteis spathulatis 8–10 mm. longis; pedicellis divaricatis vel adscendentibus 5–8 mm. longis; siliquis ellipticis carinatis pubescentibus 5–8 mm. longis 3–5 mm. latis; stylis glabris 2–3 mm. longis.

Type in the Gray Herbarium, collected on a dry hill, Birch Creek, Range 29 East, Township 11 North, Lemhi County, Idaho, July 3, 1941, *Ray. J. Davis 3801*. Other specimens examined, all from Idaho: Double springs summit, 8 miles northeast of Dickey, Custer Co., July 16, 1941, *A. Cronquist 3178* (GH); same locality, July 26, 1932, *J. H. Christ 1953* (US); in shallow soil on top of limestone at summit of grade between Challis and Dickey, Custer Co., June 13, 1944, *Hitchcock* and *Muhlick 8922* (Wash.); Head of Rock Creek, north slope of Lost River Mts., Custer Co., June 23, 1947, *C. L. Hitchcock 15727* (GH).

A second undescribed species has the siliques flattened at right angles to the replum, but the flattening does not extend to the margins, nor is there a keel produced as in *L. carinata*. This new plant, *L. Paysonii*, is related to *L. Wardii*, a species considered to be somewhat anomalous in *Lesquerella* by Watson (1888), because of its obcompressed siliques. Another species showing an even more marked flattening than *L. Wardii* was recently described as *L. hemiphysaria* by Maguire (1942). The latter entity was thought by Payson (1922) to represent *L. utahensis* Rydberg. I have not studied the type of *L. utahensis*

and cannot offer an opinion as to the correct application of the name. *L. Paysonii* belongs to this same general group of species but has a much more elongated silique than any of them. Payson supposed the plants included here were *L. prostrata*, but my collection no. 2326, from near the type locality of that species, shows it to have nearly globose fruits and but two ovules per loculus. Thus *L. prostrata* is scarcely of the same species-alliance.

Lesquerella Paysonii Rollins, sp. nov.

Perennial, densely pubescent throughout with appressed silvery stellate trichomes, rays of the trichomes 7–12, equal, free nearly to their bases; stems slender, arising laterally on the caudex, decumbent, unbranched, 3–7 cm. long; basal leaves entire, petiolate, forming a terminal rosette above the fruiting stems, blades elliptical or broader, obtuse, cuneate at base, 4–15 mm. long, 4–10 mm. wide, petioles slender, 5–15 mm. long; cauline leaves few, petiolate, obtuse to acute, 5–10 mm. long; sepals narrowly oblong, 5–7 mm. long; petals yellow fading purplish, narrowly lingulate, not differentiated into blade and claw, 10–12 mm. long, 1.5–2 mm. wide; infructescence racemose, elongated, often over half the length of the stems; pedicels ascending, slightly to markedly sigmoid, 3–7 mm. long; siliques elliptical, compressed contrary to the replum, densely pubescent, 5–7 mm. long, 3–5 mm. wide, not quite sessile, stipe less than 1 mm. long; style glabrous, 2–4 mm. long; stigma capitate, only slightly expanded; replum lanceolate, acute at apex; ovules 5–7 in each locule, funiculus attached to septum at base; seeds wingless, flattened, orbicular, ca. 1.5 mm. in diameter; cotyledons accumbent.

Herba perennis undique indumento argenteo-stellato tecta; foliis radicalibus integris petiolatis ellipticis vel ovatis; foliis caulinis petiolatis integris; caulibus simplicibus decumbentibus 3–7 cm. longis; pedicellis divaricatis, 3–7 mm. longis; siliquis pubescentibus, 5–7 mm. longis, 3–5 mm. latis; stylis glabris, 2–4 mm. longis; loculis 5–7-ovulatis; seminibus emarginatis orbiculatis ca. 1.5 mm. latis.

Type in the Gray Herbarium, collected on rocky ridges, mountains near Cottonwood Lake, east of Smoot, Lincoln Co., Wyoming, Aug. 13, 1923, *Edwin B. Payson* and *George M. Armstrong 3816*. Other specimens examined: Kendall, Sublette Co., Wyoming, Aug. 6, 1922, *E. B. & L. B. Payson 2944* (GH); calcareous summit, Teton Pass Mts., Wyoming, east of Victor, Idaho, July 25, 1920, *E. B. & L. B. Payson 2131* (GH); among rocks on summit, Caribou Mountaun, Bonneville Co., Idaho, *E. B. Payson & G. M. Armstrong 3553* (GH); Meadow Creek Ranger Station, Bear Lake Co., Idaho, June 26, 1938, *R. J. Davis 388* (GH).

Lesquerella Mcvaughiana Rollins, sp. nov.

Perennial, silvery stellate pubescent; stellae scale-like, rounded and with numerous rays united to their tips; caudex simple or with but few

branches; stems several to numerous, erect or decumbent at base, simple, densely pubescent, 5–20 cm. long; basal leaves petiolate, entire, densely pubescent with overlapping peltate trichomes, obtuse to rounded at apex, 2–5 cm. long; blade elliptical or obovate to broadly oblanceolate, 1–2 cm. long, 5–10 mm. broad; cauline leaves petiolate, broadly oblanceolate to linear-oblanceolate, 1–3 cm. long, 2–5 mm. broad; inflorescence short, dense, elongating only slightly in fruit, 1–3 cm. long; flowers white with a yellowish center; sepals densely pubescent, somewhat boat-shaped, narrowly oblong, tapering above, 3–4 mm. long; petals white fading pinkish near base, cuneate, not markedly differentiated into blade and claw, 6–9 mm. long, 4–6 mm. wide; fruiting pedicels widely spreading to slightly ascending, weakly sigmoid, 6–10 mm. long; siliques erect or ascending, glabrous, globose, not flattened, 3–4 mm. in diameter, substipitate, the stipe when present less than 1 mm. long; replum orbicular; ovules 4–6 in each loculus; funiculi attached to septum about half their length; styles 1–2 mm. long; seeds wingless, plump, very slightly longer than broad.

Herba perennis undique indumento argenteo-stellato tecta; caulibus erectis vel suberectis simplicibus 5–20 cm. longis; foliis radicalibus petiolatis integris obtusis 2–5 cm. longis, laminis ellipticis vel obovatis 1–2 cm. longis, 5–10 mm. latis; foliis caulinis petiolatis 1–3 cm. longis, 2–5 mm. latis; sepalis lineari-oblongis 3–4 mm. longis; petalis albis cuneatis 6–9 mm. longis, 4–6 mm. latis; pedicellis divaricatis plus minusve curvatis 6–10 mm. longis; siliquis erectis globosis glabris subsessilibus 3–4 mm. diametro; loculis 4–6 ovulatis; funiculis septo adnatis; seminibus immarginatis.

Type in the Gray Herbarium, collected in main canyon, east of Mt. Ord, Sierra del Norte, about 10 miles southeast of Alpine, Brewster County, Texas, April 7, 1947, *Rogers McVaugh 7862*. Other Texas specimens studied and included in the above description: steep limestone slopes, main canyon on west side of Santiago Mts., about eight miles southeast of Santiago Peak, Brewster Co., April 5, 1947, *McVaugh 7850* (GH); infrequent in upper Cottail Canyon, Chisos Mts., Brewster Co., Aug. 3, 1937, *B. H. Warnock 91* (GH); Pine Mountain, Sierra del Norte, Brewster Co., March 19, 1938, *O. E. Sperry T602* (GH); dry rocky limestone slopes, above Hess Ranch House, Glass Mts., north of Marathon, Brewster Co., March 16, 1941, *R. R. Innes & B. H. Warnock 469* (GH); abundant in shaded canyon bottoms, northeast side of Sierra Madera, about 25 miles south of Ft. Stockton, Pecos Co., April 12, 1947, *McVaugh 7912* (GH).

The ovule-number, glabrous siliques, relatively short styles and white flowers are characteristics shared by *L. Mcvaughiana*, *L. purpurea*, and *L. Johnstonii*. The latter and *L. Mcvaughiana* show further similarities in having congested infructescences and ascending siliques. There seems little doubt that all three species are, in fact, related. *L. Mcvaughiana* differs from the

others in having trichomes with the branches fused into a peltate disc, while in *L. purpurea* and *L. Johnstonii* the trichome branches are nearly or quite free to their bases. This difference is very striking and immediately sets *L. Mcvaughiana* apart as a distinct species. The latter also has entire basal leaves which contrasts with the other two species. *L. purpurea* has the pedicels recurved, while in *L. Johnstonii* they are divaricately ascending and nearly straight, and in *L. Mcvaughiana* they are widely spreading and weakly sigmoid.

Physaria

The evidence now assembled shows a continuous morphological gradation from the genus *Physaria* into *Lesquerella*. This evidence has been accumulating almost since the time Watson (1888) founded *Lesquerella* as a genus distinct from *Vesicaria*. Payson (1922) clearly recognized the proximity to *Physaria* of the entities he knew as *L. Kingii* and *L. utahensis*, and this was further emphasized by me (Rollins, 1939) as opposed to the ideas of Schulz (1936), who placed *Lesquerella* and *Physaria* in widely separated tribes of the family. More recently Maguire (1942) pointed up the close relationship of these two genera by using the specific name *hemiphysaria* for a species of *Lesquerella*. Formerly *Physaria Geyeri* was thought to be about as closely related to *Lesquerella* as any species of that genus, but a species of *Physaria* from Nevada, heretofore unknown, is even closer. Thus the assumed gap between these genera has been completely closed insofar as the morphology of the various entities involved is concerned. There remains the slender evidence from cytology which is, to say the least, very incomplete.

The basic chromosome number of *Physaria* is presumably $n = 4$. In *Lesquerella*, the known numbers are $n = 5$, 6, 8, and 9, or their multiples. If such a chromosomal separation remains, when the problem has been sufficiently investigated, it would not be unreasonable nor inconsistent with the generic pattern in the Cruciferae to maintain *Physaria* and *Lesquerella* as separate genera. There is another practical reason for maintaining the two genera. *Physaria* is the smaller and older of the two, so that all the transfers would have to be made in that direction. It is hoped that the two genera can be kept going to avoid disruptions in the nomenclature of *Lesquerella*. The following new species provides added evidence that *Lesquerella* and *Physaria* had a common origin, as Payson (l. c.) has suggested. Indeed, *P. cordiformis* forms the nearly common link between

these genera. A further word of caution should be provided for those who might be tempted to hastily merge *Lesquerella* and *Physaria* without an adequate study of the problem. These genera are closely related to *Alyssum* at least, and possibly to *Vesicaria*. *Alyssum americanum* Greene could easily be accommodated in *Lesquerella* without upsetting the present generic concept seriously, but this species is closely related, at least morphologically, to *Alyssum alpestre* L. of the Old World. Quite obviously the question of *Alyssum* vs. *Lesquerella* would need to be considered in any move to unite the latter with another genus. Kuntze (1891) has already transferred a number of the species of *Lesquerella* to *Alyssum*.

Physaria cordiformis Rollins, sp. nov.

Perennial from a tap-root, densely silvery stellate-pubescent throughout; stems several to numerous from the base, arising laterally on the caudex, simple, purplish, procumbent, 1–2 dm. long; radical leaves petiolate, terminating caudex, entire or with a few shallow teeth, 2–3 cm. long, blade rounded above, nearly orbicular to oblong, 3–12 mm. broad; cauline leaves petiolate, entire, linear-oblanceolate, 1–2.5 cm. long, 2–4 mm. wide; flowers numerous in elongated racemes; sepals narrowly oblong, outer pair slightly saccate, 4–5 mm. long; petals broadly spatulate, yellow, 7–10 mm. long, blade 2.5–3.5 mm. wide; infructescence greatly elongated, usually occupying over half the stem-length; pedicels divaricate to more ascending, sigmoid, 5–15 mm. long; siliques heart-shaped with a relatively shallow broad open sinus above and none below, sessile, densely pubescent, 3–5 mm. high, 3–5 mm. broad, compressed at right angles to the replum, not inflated; styles glabrous, 3–6 mm. long; stigma capitate; replum elliptical, rounded both above and below, not constricted, 3–4 mm. long; septum incomplete, forming a margin around the interior of the replum; ovules 3–4 in each loculus; seed wingless, brown, very slightly longer than broad.

Herba perennis caespitosa argentea stellato-pubescens; caulibus simplicibus decumbentibus 1–2 dm. longis; foliis radicalibus integris vel sparse dentatis 2–3 cm. longis, laminis orbiculatis vel oblongis 3–12 mm. latis; foliis caulinis petiolatis integris lineari-oblanceolatis 1–2.5 cm. longis, 2–4 mm. latis; sepalis lineari-oblongis 4–5 mm. longis; petalis flavis spathulatis 7–10 mm. longis, 2.5–3.5 mm. latis; racemis fructiferis elongatis; pedicellis divaricatis vel adcendentibus 5–15 mm. longis; siliquis cordiformis compressis non-inflatis pubescentibus 3–5 mm. altis, 3–5 mm. latis; stylis glabris 3–6 mm. longis; loculis 3–4-ovulatis; seminibus exalatis.

Type in the Gray Herbarium, collected near a branch of Cat Creek, in the Wassuk Range of Mountains, Mineral Co., Nevada, alt. 9,300 ft., July 8, 1945, *Annie M. Alexander* and *Louise Kellogg 4393*. Other specimens studied and included in the above description: dry chalky

lacustrine outcrop, associated with *Lepidium nanum*, 5 miles south of Sadler's Ranch, 55 miles south of Elko, on the Elko-White Pine County line, Nevada, alt. 5,000 ft., May 22, 1941, *A. H. Holmgren 829* (GH); sandy washes between calcareous gravel knolls, Lone Mountain, 18 miles west of Eureka, Eureka Co., Nevada, alt. 6,150 ft., June 12, 1944, *H. D. Ripley* and *R. C. Barneby 6220* (GH).

The latter two collections are from a lower altitude and a more northeasterly area than the type. The plants also differ somewhat from the type and may actually represent a separate, subspecific entity, with broader basal leaves, longer styles, and a more appressed pubescence on the leaves and siliques. However, the plants of all three collections have many fundamental characters in common and appear to represent variants of a single species. Further field data and a more representative sample of the species are required for a valid appraisal of these variants.

Smelowskia

For several years I have been puzzled by a plant sent in for determination by Prof. A. H. Holmgren.[1] It does not fit neatly into any of the established genera of the Cruciferae but is not sufficiently different from *Smelowskia* nor from *Braya* to form the basis of a new genus. In some respects it resembles certain species of *Arabis*, in other respects, members of *Thelypodium*. Thus the well known problem of generic definition in the Cruciferae is again emphasized. On technical characters of the flower, fruit, and seeds, the species is excluded from both *Arabis* and *Thelypodium*. It then becomes a question as to whether the characteristics of the plant are most in accord with those of *Smelowskia* or of *Braya*. Unfortunately, the new plant is not closely related to any known species in either genus, otherwise the problem would be relatively simple. Upon the evidence derived from a morphological study of the two genera and of the Nevada species, I have concluded that the latter should be placed in *Smelowskia*, where it is described below as *S. Holmgrenii*.

The basal leaves of *S. Holmgrenii* are entire, stiffly erect and glabrous except for marginal hairs. In these respects the basal portion of the plants resemble those of *Braya purpurascens* and are

[1] Professor Holmgren of Utah State Agricultural College, Logan, first sent flowering specimens in 1946. The following year, he returned to the same location in Nevada, several hundred miles distant, to re-collect the plant in fruit. I hereby express my obligation and appreciation for his keen interest and sustained effort in providing adequate material, including viable seeds, for the study of this species.

Fig. 1. A–D, *Smelowskia Holmgrenii.* A, habit sketch; B, inflorescence; C, infructescence: D, leaf-margins. E–H, *Lesquerella carinata.* E, habit sketch; F, inflorescence; G, group of 4 trichomes; H, infructescence including outline of transverse section of a single silique. Drawings by Jeanne Russel Janish.

very unlike the deeply lobed, softly pliable, and densely pubescent basal leaves of *Smelowskia*. Also the reduced cauline leaves are more nearly those of a *Braya* and quite different from the rather ample pinnatifid cauline leaves of *Smelowskia*. Here the resemblances to *Braya* end and similarities to *Smelowskia* begin. The pedicels are long and slender, as in *Smelowskia*, and free of marginal wings characteristic of the short, thickened pedicels of those species of *Braya* most closely related to the type species. The glabrous siliques, like those of other *Smelowskias*, have a very narrow replum margin, with the valves nearly touching each other across it. A prominent characteristic of *Braya* as a genus is the presence of trichomes on the valves of the siliques, although there is at least one species, *B. Longii*, where the valves are glabrous. A much more important generic character in *Braya* is the broad replum margin, much expanded toward the base. This is particularly marked in *B. Longii*, where the replum margin approaches 1 mm. in width in some plants. The stigma of *S. Holmgrenii* is entire, as in other species of *Smelowskia*, not bifid and expanded as commonly found in *Braya*.

Smelowskia Holmgrenii Rollins, sp. nov.

Caespitose perennial with a deep tap-root branching at the crown; thick caudex branches densely covered with old leaf-bases, 5–10 mm. thick, 1–3 cm. long, each sobole terminating in a dense crown of leaves; basal leaves petiolate, stiff, erect, lanceolate to linear-oblanceolate, acute, 2–5 cm. long, 3–5 mm. wide, blade tapering very gradually into the petiole, glabrous except the margins which are sparsely ciliolate; stems several, slender, glabrous, terete, erect, somewhat gyrate, branched above, 1–2 dm. high; cauline leaves 3–5, linear, glabrous, 1–2 cm. long, 1.5–3 mm. wide; inflorescence racemose; sepals linear-oblong, non-saccate, scarious-margined, purplish, glabrous, ca. 2 mm. long and 1 mm. wide; petals white, spatulate, 3.5–4.5 mm. long, ca. 1.5 mm. wide, claw about one-half the blade length; stamens nearly equal, filaments terete, ca. 2 mm. long, anthers oval, less than 0.5 mm. long; pedicels glabrous, straight, strongly ascending, filiform, slightly expanded above, 3–8 mm. long; siliques erect linear-oblong, tapering at base and apex, slightly flattened parallel to septum, 5–12 mm. long, 1–1.5 mm. wide; valves nerveless or very slightly nerved at base, purplish, depressed between the seeds; style less than 0.5 mm. long; stigma entire, unexpanded; seeds brown, wingless, not flattened, ca. 2 mm. long, ca. 1 mm. broad, slightly pointed at each end, radical slightly exceeding the cotyledons at the funicular end, in a single row in the siliques; cotyledons incumbent. Fig. I, A–D.

Herba perennis caespitosa; caudicibus ramosis foliis persistentibus tectis; foliis radicalibus erectis rigidis numerosis lanceolatis vel linearioblanceolatis acutis 2–5 cm. longis, 3–5 mm. latis; caulibus tenuibus

glabris superne ramosis 1–2 dm. altis; foliis caulinis paucis remotis linearibus glabris 1–2 cm. longis, 1.5–3 mm. latis; sepalis lineari-oblongis non saccatis glabris purpureis ca. 2 mm. longis; petalis albis spathulatis 3.5–4.5 mm. longis, ca. 1.5 mm. latis; pedicellis fructiferis adscendentibus glabris tenuibus 3–8 mm. longis; siliquis erectis lineari-oblongis acutis teretibus 5–12 mm. longis, 1–1.5 mm. latis; seminibus oblongis alatis ca. 2 mm. longis, ca. 1 mm. latis; cotyledonibus incumbentibus.

Type in the Gray Herbarium, locally frequent, crevices of rocks on rocky prominence above middle fork of Pine Creek, Toquima Range, 10,000 ft., Nye Co., Nevada, Aug. 4, 1947, *Arthur H. Holmgren* and *Cecil Ballenger 7076*. Other specimens from the same general location: summit above Pine Creek Basin, 11,300 ft., July 16, 1945, *Bassett Maguire* and *A. H. Holmgren* 25814 (GH); same location, 11,400 ft., July 17, 1945, *Maguire* and *Holmgren* 25829 (GH).

Smelowskia Holmgrenii is the third species of this genus known from North America. It is easily distinguished from *S. calycina* and *S. ovalis* because of the lack of a dense whitish tomentum which is characteristic of those species. Also, the entire, stiff basal leaves are markedly different from the subpinnatifid soft pliable leaves of these species. The fruits of *S. Holmgrenii* are more like those of *S. calycina* than other species of the genus, either American or Asiatic.

Eutrema

Up to the present only a single species of *Eutrema*, *E. Edwardsii*, has been well known from North America. This excludes species dubiously referred to *Eutrema* based on unauthenticated records. The range of *E. Edwardsii* is circumpolar in the arctic and sub-arctic, extending somewhat southward in the mountains of east central Asia. In America, it has been found from eastern Greenland (lat. 70° 50′ N. and above) west to Alaska. All of the collections are from a very northerly latitude, the type having come from Melville Island. In view of this, it was quite startling to receive specimens of a *Eutrema* from the high mountains of Colorado. The comparatively long-petioled basal leaves and short narrowly elliptical siliques are sufficiently characteristic to make the plants unmistakably referable to this genus. A comparative study of the Colorado material with that of *E. Edwardsii* shows that the two entities are actually quite closely related species.

Eutrema Penlandii Rollins, sp. nov.

Perennial, stems one to few from a slightly fleshy tap-root, decumbent to erect, glabrous, 3–8 cm. high; basal leaves petiolate, petiole very slender, 1–2.5 cm. long, blade ovate to elliptical, cordate, truncate or

cuneate below, rounded at apex, 5–10 mm. long, 3–5 mm. wide, glabrous, slightly coriaceous with a prominent mid-rib; cauline leaves 3–7, sessile, crowded, narrowly oblong, not auriculate, 1–1.5 cm. long, 2–3 mm. wide, glabrous, slightly coriaceous with a well-defined mid-rib; sepals purplish, glabrous, broadly oblong, scarious-margined, 1.5–2 mm. long, somewhat persistent after anthesis; petals white, narrowly lingulate with a very narrow claw, 2–3.5 mm. long, less than 1 mm. wide; stamens subequal, ca. 2 mm. long, equaling or slightly exceeding the sepals, anthers minute, slightly longer than broad, ca. 0.2 mm. long; infructescence crowded, 1.5–3 cm. long; pedicels divaricately ascending, glabrous, straight, 3–5 mm. long, noticeably expanded distally; siliques narrowly elliptical, glabrous, not strongly flattened, ca. 1.5 mm. wide, 4–8 mm. long; style barely evident; stigma about the same diameter as the style, not noticeably lobed; seeds not seen.

Herba perennis; caulibus paucis decumbentibus vel erectis glabris 3–8 cm. altis; foliis radicalibus petiolatis integris laminis ovatis 5–10 mm. longis, 3–5 mm. latis; foliis caulinis sessilibus non auriculatis anguste oblongis 1–1.5 cm. longis, 2–3 mm. latis; petalis albis anguste lingulatis 2–3.5 mm. longis; pedicellis fructiferis glabris divaricatis, 3–5 mm. longis; siliquis glabris 4–8 mm. longis; seminibus ignotis.

Type in the Gray Herbarium, Hoosier Pass, Park Co., Colorado, elev. 12,300 ft., July 27, 1935, *C. William T. Penland 1305.* Isotype at Colorado College. A second collection from the same area was found rooted in moss in seepage below a snowbank on south scree slope of Hoosier Ridge, at about 12,800 ft., July 26, 1949, by *C. William T. Penland 3909*, and is now deposited in the Gray Herbarium.

Eutrema Penlandii differs from typical *E. Edwardsii* in having more slender pedicels, petals which are narrowly lingulate instead of broadly spatulate to obovate, and with the smaller (5–10 mm. long) blades of the petiolate leaves usually truncate to cordate below. In *E. Edwardsii* the blades (1–3 cm. long) are most often gradually narrowed to the petiole and only rarely approach being truncate. The blades of the petiolate leaves of *E. Penlandii* are usually broadly ovate with a rounded apex, but in some plants, variation to a narrower more cuneate blade is found. The basal leaves of *E. Edwardsii* are most often narrowly elliptical with a cuneate base and somewhat pointed apex. The Colorado plant is less robust in all respects than its northern relative, having fewer, more slender, and often somewhat decumbent stems; fewer and narrower cauline leaves, smaller flowers and smaller siliques. The infructescence of *E. Penlandii* is shortened and crowded, while that of *E. Edwardsii* is often much elongated, reaching a decimeter and a half in length.

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THE GUAYULE RUBBER PLANT AND ITS RELATIVES

REED C. ROLLINS

The guayule rubber plant (*Parthenium argentatum*) is a potential source of natural rubber to be grown as an agricultural crop in the temperate regions of the world. That fact has provided the stimulus for considerable botanical research in recent years concerning guayule and other species of the genus *Parthenium*. Because it has been more thoroughly studied than any of the other species and because of its economic importance, we have felt justified in making *P. argentatum* the central theme around which a monographic study of the whole genus *Parthenium* is woven. A taxonomic revision, together with much new information of a general nature, as well as facts from scattered sources, is provided in the present monograph.

Early in the cytogenetic investigations of *Parthenium*, it was found that apomixis was common in *P. argentatum* and *P. incanum* (Esau, 1944; Powers & Rollins, 1945) and that a polyploid chromosome-series was present in each of these species (Stebbins & Kodani, 1944; Bergner, 1944). Evidence for natural hybridization (Rollins, 1944) between *P. argentatum* and *P. incanum* and subsequently the experimental production of hybrids between these and other species (Rollins, 1945 & 1946) has emphasized relationships not otherwise apparent between species. It is certain from these studies that the nature of many of the present populations has been markedly affected by introgressive hybridization. Experimental studies have shown that interspecific hybridization has affected plant vigor, percentage of rubber and time of flowering in *Parthenium* (Kramer, 1946). In some instances where apomixis is present, it has played a significant role in producing and preserving uniform populations under conditions where they would not otherwise be expected to survive. In others, natural interspecific hybridization, facultative apomixis, and polyploidy combine to affect markedly the nature of wild populations (Rollins, 1949).

In spite of the general interest shown in *Parthenium* by many different kinds of botanical and agricultural workers, no complete taxonomic treatment of the genus has ever been published. The present work attempts to present a satisfactory working key to the species of *Parthenium* and to serve as a coordinating reference for general information about them. It is the author's conten-

tion that taxonomy, more than any other branch of botany, can provide the central theme around which diverse kinds of information can satisfactorily be brought together. It is to this end that the present study has been directed. Much investigative work remains to be done upon *Parthenium*. We have just begun to gain an insight concerning the primary factors affecting population-variability. Only the broad aspects of evolutionary relationships within the genus are reasonably clear. The details remain to be worked out and there is no evident pattern to show properly the relationship of the sections. Future research, combining population analyses in the field with experimental studies in a uniform garden, should add greatly to our knowledge of the genus.

History and Relationships of the Genus

The name *Parthenium* originated with Linnaeus in the Species Plantarum and was based on plants of two herbaceous species: *P. hysterophorus* from the Island of Jamaica, and *P. integrifolium* from Virginia. The next described species, *P. bipinnatifidum*, from the highlands of Mexico, is a near relative of *P. hysterophorus* and has long been considered conspecific with it. At a relatively early date *P. bipinnatifidum* was made the basis of two separately described genera: *Villanova* by Ortega (1797) and *Argyrochaeta* by Cavanilles (1797).

Until the discovery and publication of *Parthenium incanum* by Humboldt, Bonpland and Kunth (1820), the genus was thought to be composed only of herbaceous species. However, during the rapid exploration of Mexico in the decades that followed, several additional shrubby species were discovered. In 1842, Torrey and Gray placed Nuttall's *Bolophyta alpina* (1840) in *Parthenium*, thus modifying the generic concept to include a monocephalous plant of very dwarfed habit. By this time, representatives of the four sections of the genus had been discovered and the full range of habital differences was known. These differences are one of the remarkable features of *Parthenium*. One extreme is represented by the ephemeral annual plants of *P. bipinnatifidum*, which complete their life-cycle from seed to seed in eight weeks. Among the herbaceous perennials, *P. ligulatum* and *P. alpinum* are so dwarfed that they hardly project above the gypsum-impregnated soil of their native habitat, from which they are scarcely distinguishable at a glance. Other species represent a series which culminates in the very

ligneous types represented by *P. tomentosum*. These may become large shrubs or small trees of over 15 ft. in height. In view of this great range in habit of growth, it is remarkable that such uniformity is present in the floral and reproductive structures of members of the entire genus.

Parthenium does not appear to be closely related to any other genus of the *Compositae*, even though the treatment of Baillon (1882) contains suggestions to the contrary. Here, *Parthenice* and *Aiolotheca* are given as synonyms of *Parthenium*. Both of the former are small genera of the north Mexican area and if Baillon's treatment is suggestive, one might suppose that at the very least a strong relationship between these genera and *Parthenium* would be immediately evident. However, this is not the case. The monotypic *Parthenice* shows several outstanding differences from *Parthenium* in addition to those pointed out by Gray (1853) when the genus was published. In *Parthenium*, the sterile, sessile disk-florets are shed as a unit, with disarticulation occurring on the receptacle. But in *Parthenice*, the disk-florets are shed individually with disarticulation occurring at the apex of the abortive ovaries. The latter remain as peg-like projections from the receptacle in the center of the persistent outer phyllaries. One of the singular and constant features of *Parthenium* is the fusion of the basal portion of the two subjacent sterile florets, the basal portion of the achene and its subtending phyllary. This fusion is sufficiently extensive to cause the phyllary and two florets to remain attached to the achene when it is shed. No such "achene-complex" is found in *Parthenice* nor in *Aiolotheca*.

The lack of a pappus in *Parthenice* is not as significant as supposed by Gray, since it is absent or obscure in such species of *Parthenium* as *P. tomentosum* and *P. fruticosum*. However, it is significant that in *Parthenice* the corolla is not persistent on the achene and the paleae do not invest the sterile florets as in *Parthenium*.

Aiolotheca is a monotypic genus which is very imperfectly known. I have examined an isotype of *A. parthenioides* and one other old Berlandier specimen in the Gray Herbarium, but no modern material has been available for study. The achenes of *Aiolotheca* lack marginal ribs to which subjacent, sterile florets are fused as in *Parthenium*. Fertility is not confined to the ray-florets in *Aiolotheca*, but the adjacent disk-florets are often fertile, producing more or less spindle-shaped achenes. Cer-

tainly, the characteristic "achene-complex" of *Parthenium* is not approached by the fruits of *Aiolotheca* and merging the two genera would seem to be unjustified.

Economic Importance

So far as is now known, *P. argentatum* is the only species containing sufficient quantities of rubber to be of direct economic importance. There is a slight trace of rubber in some biotypes of *P. incanum*, but other woody species examined, such as *P. tomentosum*, its variety *stramonium*, and *P. fruticosum*, do not have rubber present in their tissues. The herbaceous species, such as *P. hysterophorus*, *P. bipinnatifidum*, *P. confertum*, and *P. integrifolium*, do not produce rubber. Other species have not been examined but there are reasons for supposing that they produce little or no rubber. Some of the species of *Parthenium*, such as *P. incanum*, *P. tomentosum*, *P. fruticosum*, *P. Lozanianum*, etc., have desirable growth or physiological characteristics and may become important when used in crosses with *P. argentatum* to produce superior new strains of rubber plants.

Early records on the actual amount of guayule rubber produced from wild stands of shrub are difficult to obtain. However, many areas in Mexico have had the shrub harvested one or more times since the commercial exploitation began, just prior to 1900. The largest amounts of guayule rubber, exceeding 10,000 tons per year, were produced prior to the major development of the para rubber industry. Since then, there has been some production of guayule rubber for special purposes over the years. During World War II, guayule rubber was again in great demand. Production in Mexico was entirely from wild plants, but in the United States over 30,000 acres of land were planted to guayule. At the end of the war, only a small percentage of this acreage had been harvested.

The potential economic importance of guayule rests upon many factors, most of which are nonbiological. However, from both botanical and agronomical standpoints, there seem to be no reasons why guayule may not eventually become a fully domesticated crop-plant forming a small but important source of natural rubber to be grown in temperate regions of the world. Fortunately for the ultimate improvement of guayule, there are numerous biotypes of this species. These differ rather widely in cultural characteristics, physiological behavior and in their morphology. The most marked differences are often traceable

to the effects produced by interspecific hybridization. For example, a marked depression in the percentage of rubber in the F_1 hybrid results from crossing guayule with mariola (*P. incanum*). Also, some of the most vigorous biotypes found in the wild, and differing rather markedly from straight guayule, are the result of introgressive hybridization between these two species.

Mariola (*P. incanum*) contains very small quantities of rubber, but this species by itself will not become commercially important for rubber production. It is reported to have medicinal properties and to be used somewhat as a domestic remedy for liver troubles. According to Gregg (in lit. to Gray), *P. hysterophorus* is sometimes used in the preparation of a tonic for the hair, as a tea for colic, and as a poultice for tumors, by the native Mexicans near Monterrey. Otherwise, this species is weedy enough to be a pest in some agricultural areas.

Morphology

The general morphology and anatomy of *Parthenium argentatum* have been worked out in considerable detail and various aspects are presented in such publications as those of Lloyd (1911), Artschwager (1943), and Esau (1946). In these studies, some effort was made to relate the data or descriptive matter to one or two other species of *Parthenium*, usually *P. incanum* or *P. hysterophorus*. I have made no effort to extend these studies, except to relate them to other species of the genus where possible.

Root-system. An exhaustive treatment concerned with the root-system of guayule in relation to its environment has been published by Muller (1946). All of the species of *Parthenium* begin with a taproot-system, but the original taproot may lose its prominence as the intricate system of laterals and their branches develops, especially in the woody species. In appropriate soils, the root-systems of guayule and mariola are known to be very extensive. Fourteen-year-old plants under cultivation have been shown to possess roots reaching to an extreme depth of twenty feet. Plants of these same species investigated in the wild in Texas showed a much shallower root-development, with perhaps a greater tendency for the root-system to spread laterally. Rarely did the roots penetrate the soil below 2 feet.

An interesting type of root-sprouting is common enough in guayule to be a significant factor in survival, particularly under conditions where rapid erosion occurs. Where roots come to the

surface, as might occur on a steep rocky slope, or where they are exposed by erosion, root-sprouts very often occur. These offset-shoots arising from adventitious buds on the roots, are called retoños in Mexico. They serve to start new plants under conditions where seedlings could not possibly survive. The regenerative power of roots, at some little distance from the parent plant, is particularly marked in guayule. Ultimately, the root degenerates between retoño and the parent plant and the new offset becomes completely independent.

In plants of the section *Bolophytum*, the root is somewhat expanded at the crown upon which the persistent leaves are borne. There are no evident external markings separating the stem and root. In fact, the stem is so telescoped as to appear as merely an expanded terminal portion of the main root. Many of the branches, ultimately comprising the numerous soboles of a given plant, appear to come from adventitious buds. In these cases the offsets are close to the parent plant, maintaining live connections with it for many years. Gradually the outermost offsets become independent and in turn give rise to a new group of soboles.

The roots of members of the section *Partheniastrum* are distinctive in *Parthenium* because they are often much enlarged. In *P. integrifolium*, especially, the root is usually swollen, producing a tuber-like structure. There is a creeping tendency in the roots of *P. hispidum* and they are most often without a tuber-like swollen portion. However, specimens have been seen with these swollen portions present.

Stems. One of the outstanding features of *Parthenium* is the extreme range of variation of stem-types. Species of section *Bolophytum* have such a condensed stem that there is no clear hiatus between stem and root. In these types, the stem-structure is non-woody and the nodes are extremely close together, the leaves being very crowded. The older plants of both species of this group, *P. alpinum* and *P. ligulatum*, have numerous soboles aggregating into low, dense clumps of varying diameter. These soboles seldom project more than a centimeter or two above the ground surface and persist over many seasons. Elongated herbaceous stems are found in sections *Partheniastrum* and *Argyrochaeta*. The species of the former group are perennials and the stems die back to the ground-surface at the end of the growing-season. The new stems each year arise from adventitious buds on the root-crowns. In the annual species, such as *P. bipin-*

natifidum and *P. hysterophorus*, of the latter section, the stems are softly herbaceous and usually persist only through a single growing-season. However, the roots will continue to produce new shoots for at least three years if the plants are continuously cut back.

All of the species of section *Parthenichaeta* are woody and range from low shrubs to small trees. An interesting feature of this group is that they usually produce flowers while the stems are still relatively herbaceous in their first year of growth. The lignification of the stems extends from the first year onward. Sprouting is rather general in this group and if an older plant is injured by frost or in some minor way, new shoots often arise near the ground-level.

Comprehensive anatomical studies have been carried out upon the stems of *P. argentatum* (Artschwager, 1943; Lloyd, 1911; Ross, 1908). The major amount of rubber in this species is laid down in the vascular rays of the stems but it is also found in the living parenchyma cells of most tissues of both stems and roots. The extent of lignification even in old stems is less in *P. argentatum* than in the nearly related *P. incanum* or, in fact, any of the other species of section *Parthenichaeta*. This lack of heavy lignification may be connected with rubber-production, since *P. argentatum* is the only species known to produce significant amounts of it. Also, lack of lignification may account for the fact that the stems of *P. argentatum* are very brittle compared to other species of its group.

LEAVES. The range in leaf-types in *Parthenium* is almost as great as the stem-types. Again, at one extreme are the undifferentiated reduced and slightly flattened leaves of *P. alpinum* and *P. ligulatum*. Here it is difficult to distinguish between petiole and blade. The leaves are borne in dense clusters interspersed with tufts of long whitish trichomes. In both the juvenile and older plants, the leaves are all of a single sort. The simplicity shown appears to be the result of reduction.

Perhaps the most highly differentiated leaves are found in the species of sections *Partheniastrum* and *Argyrochaeta*. In these groups, the basal leaves are somewhat different from the cauline, being sharply differentiated into blade and long petiole. The lower cauline leaves are most like the basal and there is a gradation towards the sessile leaves of the upper stems. Entire leaves characterize *P. integrifolium* and some forms of *P. hispidum*, while highly divided leaves are found in *P. hysterophorus*, *P. bipinnatifidum* and their relatives.

The upper and lower surfaces of the leaves of *P. argentatum* and *P. incanum* are very similar in most instances and are usually at least superficially indistinguishable. However, in the species of this section related to *P. tomentosum*, there are marked differences between the upper and lower leaf-surfaces. In this group, the leaves tend to be the largest of the woody members of the genus. The leaves of *P. tomentosum* are relatively persistent and remain attached long after they have normally died. The shedding is fairly continuous, the trunk and major branches becoming free of leaves except at their extremities.

The leaves of *P. argentatum* have been the subject of closer study than those of other species. Shrubby plants of this species are never completely leafless, but a relatively large proportion of the leaves are shed in winter and spring prior to new growth. The leaves of the dry season or of winter are smaller and somewhat contracted compared to those of the active growing-season. Leaves produced experimentally under moisture-stress simulate those of the dry season in Texas and Mexico. They are markedly smaller, less toothed, and more densely covered with trichomes than comparable leaves of a plant grown under conditions of abundant water-supply.

Trichomes. All species of *Parthenium* are at least partially covered with trichomes and some species such as *P. argentatum*, *P. incanum*, *P. tomentosum*, etc., have a very dense indument. There are a number of different types of trichomes in the genus, ranging from those of the malphigiaceous type of *P. argentatum* to the long tortuous ones of *P. incanum*, *P. cineraceum*, *P. tomentosum*, etc. The commonest type in the genus is nearly straight and pointed, with the largest cell at the base and with cell-size diminishing to the tip. Trichomes of the floral parts often follow the same pattern, except that the terminal cell is likely to be larger than any of the others. In the ontogeny of the leaf of *P. argentatum*, the trichomes are fully differentiated at a very early stage and the content of the mature trichome has usually disappeared by the time the leaf is fully expanded. This fact is of some importance in experiments concerned with the effects of the environment upon plant parts. The trichomes, being fully formed at such an early stage, remain unaffected by factors which may markedly affect the living cells of the leaf. Though the trichomes of the genus are varied as to type, it should be noted that none are unicellular.

Flowers and Fruit. The uniformity of most of the floral

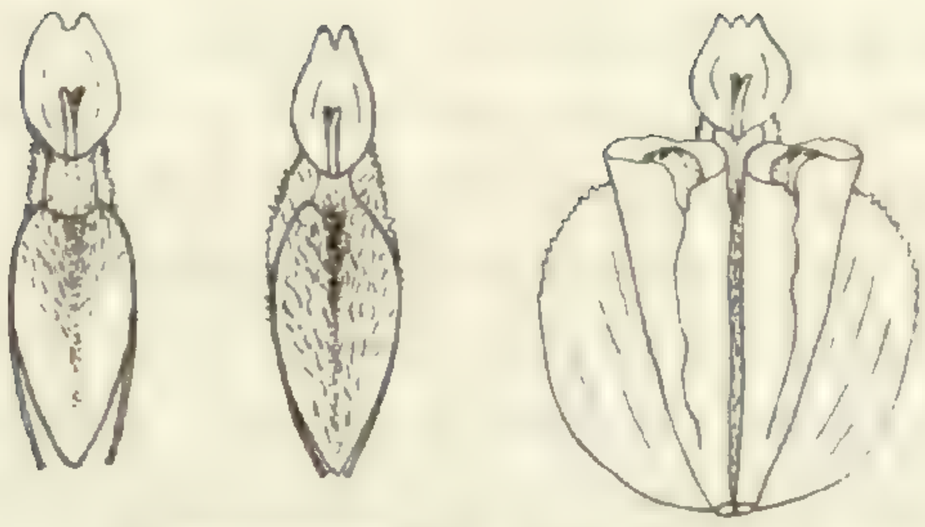
parts throughout *Parthenium* is as remarkable as the great diversity of the stems, leaves, and other structures. In each head, there are five fertile ray-florets, each with two attached subjacent seed-sterile disk-florets.[1] These two disk-florets do not differ structurally from others of the disk-portion of the head except for their attachment at the base of the achene. There is an actual fusion of tissue at the achene-base involving the lateral ribs of the achene itself, the base of the two disk-florets and the subtending bract. All of these structures remain attached when the achene is shed. The corolla of the ray-floret is persistent and is a part of the achene-complex.

The ray-florets are completely unisexual, having no visible remnants of stamens present. The disk-florets, on the other hand, do possess an abortive pistil together with the fertile stamens. The stigmas of the two types of florets are very different. That of the ray-floret is deeply cleft with pollen-receptive tissue extending from the tip down the inner surface of each lobe. The lobes may be erect or spreading, depending upon the species. The stigmas of the disk-florets are capitate with numerous well-developed glandular cells extending from the apex over the swollen portion.

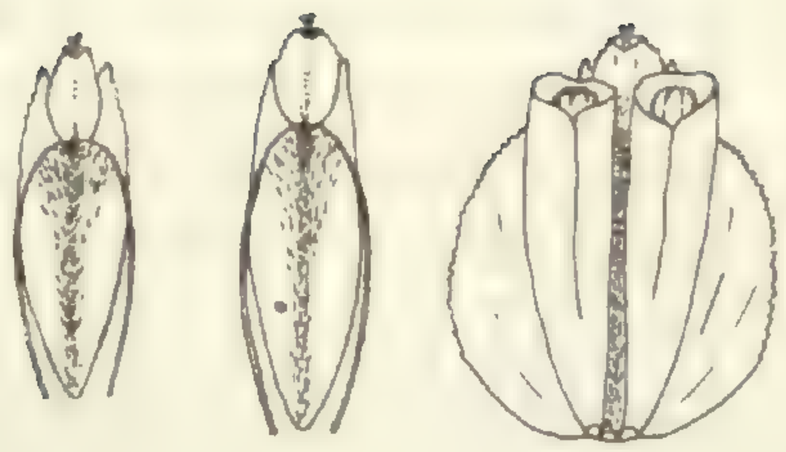
The maturation of florets in the head is centripetal. The ray-florets mature first, followed by the disk-florets nearest them and successively inward. In *P. argentatum*, the stigmas of the ray-florets are pollen-receptive as soon as the lobes begin to separate. The newly expanded stigma-lobes are very turgid and whitish. If compatible pollen is introduced, and fertilization occurs, the stigma-lobes usually begin to turn brownish within a 24-hour period. Ultimately, they become quite dark. Where pollination is not effected or where incompatible pollen is used, the stigma remains whitish and turgid for several days. Watching the stigma is not an infallible way of determining that a pollination has "taken," but it is a valuable rule-of-thumb indication of whether pollination has been effected, at least in *P. argentatum*, *P. incanum*, and *P. tomentosum*.

The disk-florets, except for the outer row, are somewhat attached to each other at the base and fall from the head in a cluster. This "center portion" of the head is usually shed along with the achene-complexes or ahead of them, ultimately leaving only the five involucral bracts at the summit of a peduncle.

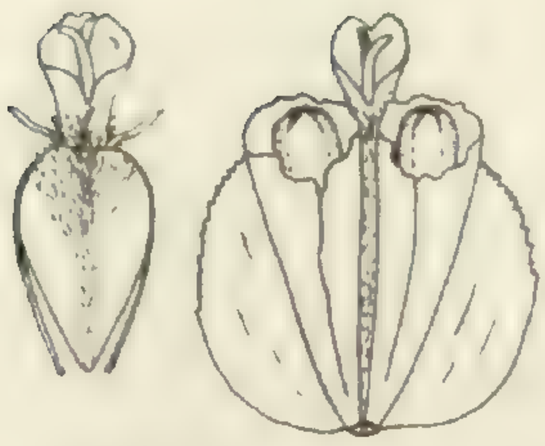
[1] In rare instances, the number of ray-florets in a head may be four, six, or even seven. But these are clearly aberrant heads, and the fact they occasionally occur does not invalidate the stated generalization.



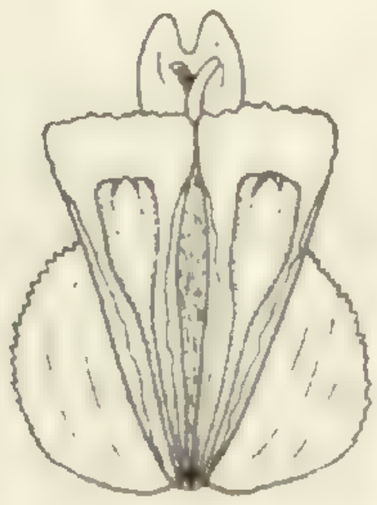
1. PARTHENIUM LIGULATUM



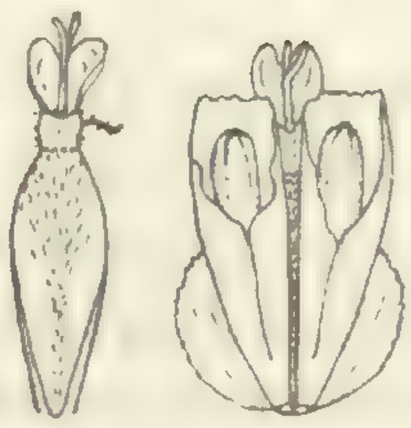
2. PARTHENIUM ALPINUM



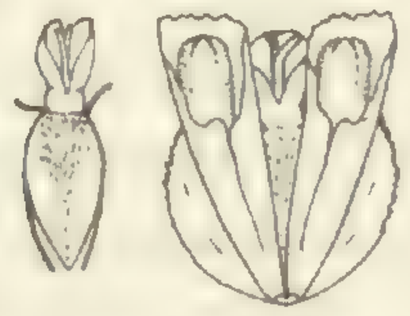
3. P. INTEGRIFOLIUM



4. P. TOMENTOSUM



5. P. CINERACEUM



6. P. FRUTICOSUM

7. P. HYSTEROPHORUS

8. P. ARGENTATUM

9. P. INCANUM

10. P. GLOMERATUM

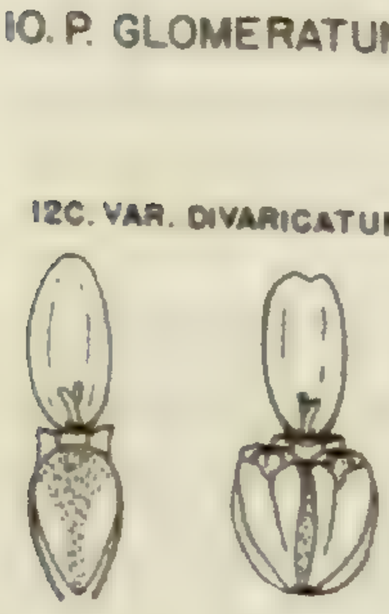
11. P. BIPINNATIFIDUM

12A. VAR. TYPICUM

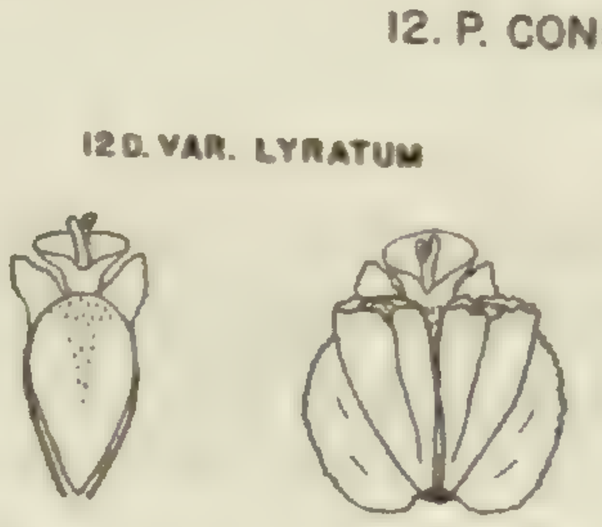
12B. VAR. MICROCEPHALUM

12. P. CONFERTUM

12C. VAR. DIVARICATUM



12D. VAR. LYRATUM



12E. VAR. LYRATUM

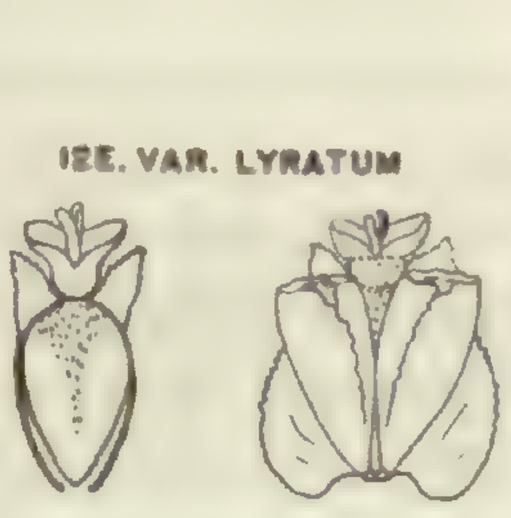


Fig. 1–12. Achenes and achene-complexes of various species of *Parthenium*, all about four times natural size. In each case, the achene-complex consists of a fertile ray-floret subtended by a phyllary together with two disk-florets

Each disk-floret is subtended by a bract which usually surrounds it, investing the floret either partially or wholly. An exception is *P. tomentosum* where these bracts merely subtend the disk-florets. In some species, such as *P. cineraceum*, this bract is somewhat hooded above and may have something of a callus at its apex. Glandular hairs are abundant at the top of these bracts. The behavior of the pistil in the disk-florets is similar to that of many other *Compositae*. As the stamens mature, they project slightly from the corolla, while an elongating style pushes the club-shaped upper portion through the staminal column, bringing a major part of the pollen to the surface. Insects attracted to the disk-portion of the head by glandular hair-secretions inevitably become covered with pollen and act as agents of transport of this pollen to other plants. The pollen from plants of sections *Bolophytum*, *Partheniastrum*, and *Argyrochaeta* is white, while the pollen of section *Parthenichaeta* is yellow. It is interesting to note that only herbaceous species have the white pollen, while all the shrubby members of the genus have yellow pollen.

There is some question as to whether the involucre should be thought of as a single whorl of five bracts alone (Artschwager, 1943), or whether the next inner whorl subtending the ray-florets should also properly be called involucral. The bracts of the second whorl, subtending the ray-florets as they do and being somewhat fused with each floret, are similar to those of the disk-florets. They seem morphologically closer to these bracts of the disk-florets than to those of the outer whorl. In fact, the bracts or phyllaries of the whole head are quite similar and appear to me, following Gray, (1884), not to require distinguishing terms. Under each species, I have described in some detail only the outer whorl of phyllaries (involucre) and the next inner group subtending the ray-florets.

The achenes of *Parthenium* are black when mature, although

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lying against the inner face of the achene. All are fused together at the base and fall from the head as a unit when the achene is mature. The figures were drawn from the following collections: fig. 1, Rollins 3087; fig. 2, Porter 4425; fig. 3, Heller 14157; fig. 4, Pringle 9384; fig. 5, Peredo 98; fig. 6, achene—Kenoyer & Crum 3645, achene-complex—Nelson 2965; fig. 7, achene at right—Churchill s. n. from Jamaica, achene-complex and achene at left—Norvell 11/3/47; fig. 8, Rollins s. n. var., 593; fig. 9, achene at left—Kenoyer & Crum 2621, achene-complex and adjacent achene—Hinton 16719; fig. 10, Fiebrig 3017; fig. 11, Rollins 481014; fig. 12A, Gregg 644; fig. 12B, Cory 17587; fig. 12C. Stewart 1662; fig. 12D, Rollins 47290, 2n = 72; fig. 12E, Rollins 47279, 2n = 34.

in some species they appear gray or whitish because of the covering of white achenial trichomes. These trichomes of the achenes range from short papillae in such species as *P. confertum* to the relatively long hairs on the achenes of *P. alpinum*. The abundance, and place of occurrence upon the achene, differs from species to species. In the illustrations, fig. 1–12, the achenial trichomes are shown as black marks upon the white achene. Actually, the achenes are black and the trichomes white.

The pappus may consist of two broad pales attached laterally upon the achene (fig. 12) as in *P. confertum*, or may be composed of three awn-like structures as in *P. incanum* or *P. argentatum*. Two of these awns are lateral with the third attached to the ventral side of the achene at the base of the corolla-tube. The two pales are consistently present in those species possessing them, but there is variation as to the number of awns present and they are absent entirely in some plants. These variations are noted under the species. It is of interest that the pappus becomes fused with the corolla-tube in *P. alpinum* and *P. ligulatum* and in some plants appears to be merely wing-margins of the corolla.

Upon first examination, it would seem that the awn-like pappus and the broad pales are quite distinct structures and that both types would scarcely be expected to occur within a single genus. However, in one specimen of *P. incanum*, a species normally having awn-like pappus, the awns were blunt with the denser portion forked and with a margin of fused transparent trichomes giving the basic structure of a pale. Furthermore, in *P. confertum*, var. *lyratum*, normally having pales, a specimen having a nearly awn-like pappus has been observed. It is not known at present whether such observations have any phylogenetic significance, but they suggest that a transition from one pappus-type to the other may be a relatively easy one. Also, this may be evidence that the herbaceous *P. confertum* arose from *P. incanum*, a course of evolution supported to some extent on other grounds.

Chromosomes

The chromosomes of *Parthenium* are small, relatively uniform, and numerous. Such a combination of characteristics makes it practically impossible to obtain useful information upon the morphology of the chromosomes themselves. In some plants of *P. argentatum*, B or "miniature" supernumerary chromosomes

occur. These usually stain very lightly at the meiotic metaphase and are "out of rhythm" with the regular chromosomes of the complement. They are not constant in number even in a single progeny of plants. So far as is known, these B chromosomes are genetically inert. Aside from the B chromosomes, there is a wide range in chromosome-number within *P. argentatum* and *P. incanum*. Both aneuploid and polyploid plants and groups of plants exist, and the work of Bergner (1946) should be consulted by those interested in more details in this connection. The polyploid series of $2n = 36 +$, $54 \pm$ and $72 \pm$ chromosomes in wild plants of *P. argentatum*, and a similar series of $2n = 54 \pm$, $72 \pm$ and $90 \pm$ in *P. incanum*, are of taxonomic importance, particularly with reference to introgressive hybridization between these two species. A polyploid plant of *P. confertum*, var. *lyratum*, having about 102 chromosomes, arose in a culture normally having $2n = 68$. This, together with the fact that $2n = 34$ characterizes one collection, shows that genomic increase in chromosome-number can take place in section *Argyrochaeta* as well as in other sections of the genus. In addition, there is good evidence that a polyploid of *P. hysterophorus*, or a very close relative of this species, occurs in Argentina. The latter case is discussed under *P. hysterophorus* in the taxonomic section of this paper. The discovery of $2n = 36$ for *P. ligulatum* and *P. alpinum*, and $2n = 72$ for *P. alpinum*, var. *tetraneuris*, brings to light another polyploid series. Thus polyploidy is known to be present in every section of the genus except *Partheniastrum*.

Previously reported chromosome-numbers such as those for *P. hysterophorus*, $2n = 34$ (Bergner l. c.; Rollins, 1946); *P. tomentosum*, $2n = 36$; *P. tomentosum*, var. *stramonium* (as *P. stramonium*), $2n = 36$; *P. confertum*, var. *lyratum* (as *P. lyratum*), $2n = 68$, are not included in accompanying Table I. With this added information upon chromosome-numbers, it is now evident that there are at least two groups of species in the genus with respect to their basic chromosome-number. In section *Argyrochaeta*, *P. hysterophorus* with $2n = 34$ and *P. confertum*, var. *lyratum* with $2n = 34$ and 68 fit one pattern, while all of the species so far investigated in the other sections are either $2n = 36$ or derivatives of that number. If, as seems probable, $2n = 36$ is the diploid number for *P. argentatum*, *P. tomentosum*, and its var. *stramonium*, *P. fruticosum*, *P. ligulatum* and *P. alpinum*, it appears that $x = 18$ is the fundamental or basic number for sections *Bolophytum*, *Partheniastrum* and

TABLE I. CHROMOSOME-NUMBERS IN PARTHENIUM[1]

Species or Variety	*Place of Collection*	*Culture- or Collection-Number*[2]	*2n Chromosome-Number*
P. confertum var. *lyratum*	Saragosa, Texas	47289	72
" "	2 mi. south of Pecos, Texas	47290	72
" "	10 mi. south of Marathon, Texas	47293	ca. 68
" "	10 mi. south of Marathon, Texas	47294	68
" "	3 mi. south of Malaga, New Mexico	47288	68
" "	114 km. west of Saltillo, Mexico	47295	68
" "	15 mi. south of Marathon, Texas	47279	34
P. bipinnatifidum	9 km. north of Pachuca, Hidalgo, Mexico	47276	24
" "	10 km. southwest of Rio Nazas, Durango, Mexico	481012	24
" "	60 km. west of Mapimi, Durango, Mexico	481013	24
" "	Zapitillo, San Luis Potosí, Mexico	481015	24
" "	Near Ascuña Villa, Puebla, Mexico	481007	24
P. hysterophorus	South of Valles, San Luis Potosí, Mexico	47284	34
" "	40 km. south of Valles, S. L. P., Mexico	481017	34
" "	Near Monterrey, Nuevo León, Mexico	47281	34
" "	Near Monterrey, Nuevo León, Mexico	47283	34
" "	Between Sabinas, Hidalgo and Ciénega, N. L., Mexico	47280	34
" "	Villa Juarez at Monte, Tamaulipas, Mexico	47286	34
" "	In the state of Tamaulipas, between Valles, San Luis Potosí, and Ciudad Victoria	47285	35
" "	Cerro Las Rosas, near Córdoba, Argentina	7363	ca. 34
P. hispidum	Near Winona, Shannon County, Missouri	47213	72
" "	Near Winona, Shannon County, Missouri	47216	72
" "	Near Salem, Dent County, Missouri	47218	72
P. integrifolium	C. C. Deam's garden, Bluffton, Indiana. Plants originally from northwestern Indiana	47292	72
P. fruticosum	20 km. south of Villagran, Tamaulipas, Mexico	47220	36
" "	522 km. north of Mexico City in the state of San Luis Potosí, Mexico	481029	36
" "	522 km. north of Mexico City in the state of San Luis Potosí, Mexico	481028	36
" "	522 km. north of Mexico City in the state of San Luis Potosí, Mexico	481027	36
P. ligulatum	Uintah County, Utah	3088	36
P. alpinum	Niobrara County, Wyoming	4855	ca. 36
P. alpinum var. *tetraneuris*	Pueblo County, Colorado	8305	72
P. incanum	35 km. west of Saltillo, Coahuila, Mexico	481001	54
" "	114 km. west of Saltillo, Coahuila, Mexico	481002	54
P. argentatum	20 km. west of Mapimi, Durango, Mexico	47296	36

[1] Chromosome-numbers previously reported are not included in this table. Many of the chromosome-numbers included here were determined by Miss Mary E. Riner, to whom I express my appreciation.

[2] Seeds have been received from sources too numerous to mention individually, but I should like particularly to record my indebtedness to Dr. C. L. Porter of the University of Wyoming, and to Mr. O. W. Norvell of Palo Alto, California, both of whom have especially aided my work by providing significant material.

Parthenichaeta. The basic number of section *Argyrochaeta* would seem to be x = 17, but this leaves the $2n = 24$ of *P. bipinnatifidum* not properly accounted for. The latter is the lowest number so far found in the genus. However, the total evidence points away from x = 9 as the basic number for the polyploid series of guayule and its closest relative *P. incanum*, as suggested by Stebbins and Kodani (1944), and supports x = 18 as accepted by Bergner (1946).

Reproduction

Facultative apomixis is more commonly involved in seed-production in *P. argentatum* and *P. incanum* than the sexual process, although both occur. Esau (1946) found that apomixis in these species mainly involves generative apospory followed by unreduced pseudogamy. However, somatic apospory, reduced pseudogamy and such other modifications as nonreduction followed by fertilization occur also. These phenomena have a marked effect upon the ultimate phenotype (Powers and Rollins, 1945), particularly where interspecific hybridization plays a part (Rollins, 1946). Seed-viability in *P. argentatum* is rather consistently below fifty per cent and in cultivated fields in California averaged as low as twenty per cent (Benedict and Robinson, 1946). Tests proved that the non-viable seeds did not possess normally developed embryos. Various factors adversely affect seed-viability in this species, but one of the most potent is undoubtedly failure or partial failure of fertilization. In apomictic types, fertilization of the endosperm-nuclei is necessary for the development of the embryo. Even in the sexual phase of the species, failure of fertilization appears to be responsible for a large proportion of the non-viable seeds produced. In *P. argentatum*, the diploid 36-chromosome plants are sexual, while the polyploid 54, 72 and higher chromosome-types are facultatively apomictic. *P. incanum* is the only other species of *Parthenium* known definitely to show facultative apomixis, but certain cultures of *P. confertum*, var. *lyratum* were sufficiently uniform to suggest that apomixis might be involved. However, experimental proof is lacking in this connection. The cultures tested of *P. hysterophorus*, *P. fruticosum*, *P. tomentosum* and its variety *stramonium* were all found to reproduce sexually. The geographic distribution of the sexual phase of *P. argentatum* is apparently limited to the general area centering on eastern Durango, Mexico. Polyploid facultatively apomictic types are

common southeastward and northward, including all of the Texas area. Since the diploid sexual phases of this species must have preceded the polyploid apomictic phases, it appears to be a sound deduction that the species occupied the Durango area first, ultimately spreading to its present range.

Hybridization

Intermediate hybrids between *P. argentatum* and *P. incanum* are relatively rarely found in the wild (Rollins, 1944) but the exchange of genic materials between these species has produced many modifying effects on both of them in the areas where their geographic ranges overlap. The most thoroughly studied introgressed populations (Rollins, 1949) are on the *P. argentatum* side of the F_1 between the species. Here, it is evident that traits of *P. incanum* in modified form have become thoroughly incorporated into the make-up of these populations. Geographically, these introgressed populations appear to be far more abundant in the areas where polyploidy and facultative apomixis occur than where the sexual phase of *P. argentatum* is found. However, they occur over a wide range of the overlap between the two species. Populations of *P. argentatum* showing introgression differ as to the extent of penetration of the introgressing elements. Some of these deviate only slightly from pure *P. argentatum*, while others are composed solely of individuals showing marked characteristics derived from *P. incanum*.

In spite of introgression between these species being fairly general, the taxonomic picture is not a hopeless one. A more detailed discussion of this is given below in the taxonomic treatment.

There is evidence of natural hybridization between other species of *Parthenium* though it is meagre compared to the mass of information concerning *P. argentatum* and *P. incanum*. When the latter species was crossed with *P. tomentosum* a hybrid was produced having the unreduced chromosome-number from *P. incanum* ($2n = 54$), plus 18 chromosomes from the male *P. tomentosum* parent. This hybrid with approximately 72 chromosomes was vigorous, pollen- and seed-sterile and, as was expected, resembled *P. incanum* more than it did *P. tomentosum*. Plants simulating this hybrid in a very general way have been found near Monterrey and in Coahuila by Mr. James Hinton. Whole populations of this plant occur and appear to be relatively stable. It is fairly certain that the plants in question are actually

of hybrid origin and that in addition to *P. incanum* one of the broad-leaved species is a putative progenitor. *P. tomentosum* is far removed from the area so that it must be ruled out as a possibility. A more likely choice is *P. Lozanianum* or possibly *P. fruticosum*, both being geographically closer than *P. tomentosum*, but neither is in the actual area where the hybrids have been found. If either of them were, in fact, a progenitor, its participation in the production of these hybrid-like plants must have been at a remote time and place. At this point it may be well to call attention to the obvious fact that plants of "hybrid origin" are not necessarily the same as an "F_1 hybrid." True enough, the parents of a hybrid must be together when the initial cross occurs. But once the hybrid has been produced, it may successfully spread to areas completely outside the range of the original parental species. Also, the geographical range of either or both of the parental species may become altered, leaving the plants of "hybrid origin" outside the present range of either or both.

Circumstantial evidence points to the hybridization of *P. hysterophorus* and *P. confertum*, var. *lyratum*. Two merging morphological types have been regularly determined as "*lyratum*." One of these has a lyrate basal leaf and matches the type. The other has a pinnate basal leaf, smaller heads, slender peduncles, and other characters tending toward *P. hysterophorus*. Cultures of both leaf-forms showed a chromosome-number of $2n = 68$. Attempts to separate the two forms from geographical and clear morphological evidence proved to be a hopeless task. The merging combinations of characters were so complex as to defy a sensible separation. The significant point is that there are *hysterophorus*-like characteristics found in var. *lyratum* and these must have had their origin in hybridization. The proof of such an assumption remains for future investigation.

Aside from the known and probable natural hybrids mentioned above, artificial hybrids have been produced between a number of species not now in contact with each other in the wild. Such a cross as that of *P. argentatum* × *P. tomentosum* attests to the relatedness of these species, although they are at present geographically separated. The chart shown as Fig. 15 (Rollins, 1946) gives the various crosses that have been made in the genus. From the progenies of these crosses a rough estimate of the compatibility of the various species used was made. *P. argentatum* and *P. incanum* are closely related and highly compatible

when intercrossed. Both are sufficiently compatible with *P. tomentosum* and var. *stramonium* to cross readily with them, but incompatibility factors are definitely operative in their progenies. *P. hysterophorus* would not cross with *P. tomentosum* and is only remotely related to *P. incanum* and *P. argentatum*, crossing with them only under very special circumstances.

Geographical Distribution

All of the species of *Parthenium* are native to the Western Hemisphere. *P. hysterophorus* is now a widespread weed in certain subtropical and temperate regions of both hemispheres and its original distributional area is difficult to establish. However, the best supposition is that this species is native to the West Indies and to the North American continent adjacent to the Gulf of Mexico. The distribution of the genus as a whole centers in Mexico, where species of sections *Parthenichaeta* and *Argyrochaeta* are particularly abundant. One species of each of these sections, *P. cineraceum* of the former, and *P. glomeratum* of the latter, is restricted to southern Bolivia and northern Argentina. Otherwise, the most southerly species is *P. Schottii*, in Yucatan. The tropics are devoid of *Parthenium*. The disjunction of the genus, by its absence from the area from southern Mexico to southern Bolivia, is not an uncommon pattern, found in other genera of plants.

Members of two of the sections of *Parthenium* are found wholly north of Mexico. Section *Bolophytum*, consisting of *P. alpinum* and *P. ligulatum*, is confined to the Rocky Mountain area. The former species is known from two localities in central and eastern Wyoming, with var. *tetraneuris* present in southeastern Colorado. *P. ligulatum* is apparently confined to the Uintah Basin of northeastern Utah. Two species, *P. integrifolium* and *P. hispidum*, make up section *Partheniastrum*. This group occurs in central and southeastern United States. Of the two species, *P. integrifolium* is by far the more widespread, as indicated in fig. 17. It is also the most northerly representative of the genus.

Phylogenetic Trends within the Genus

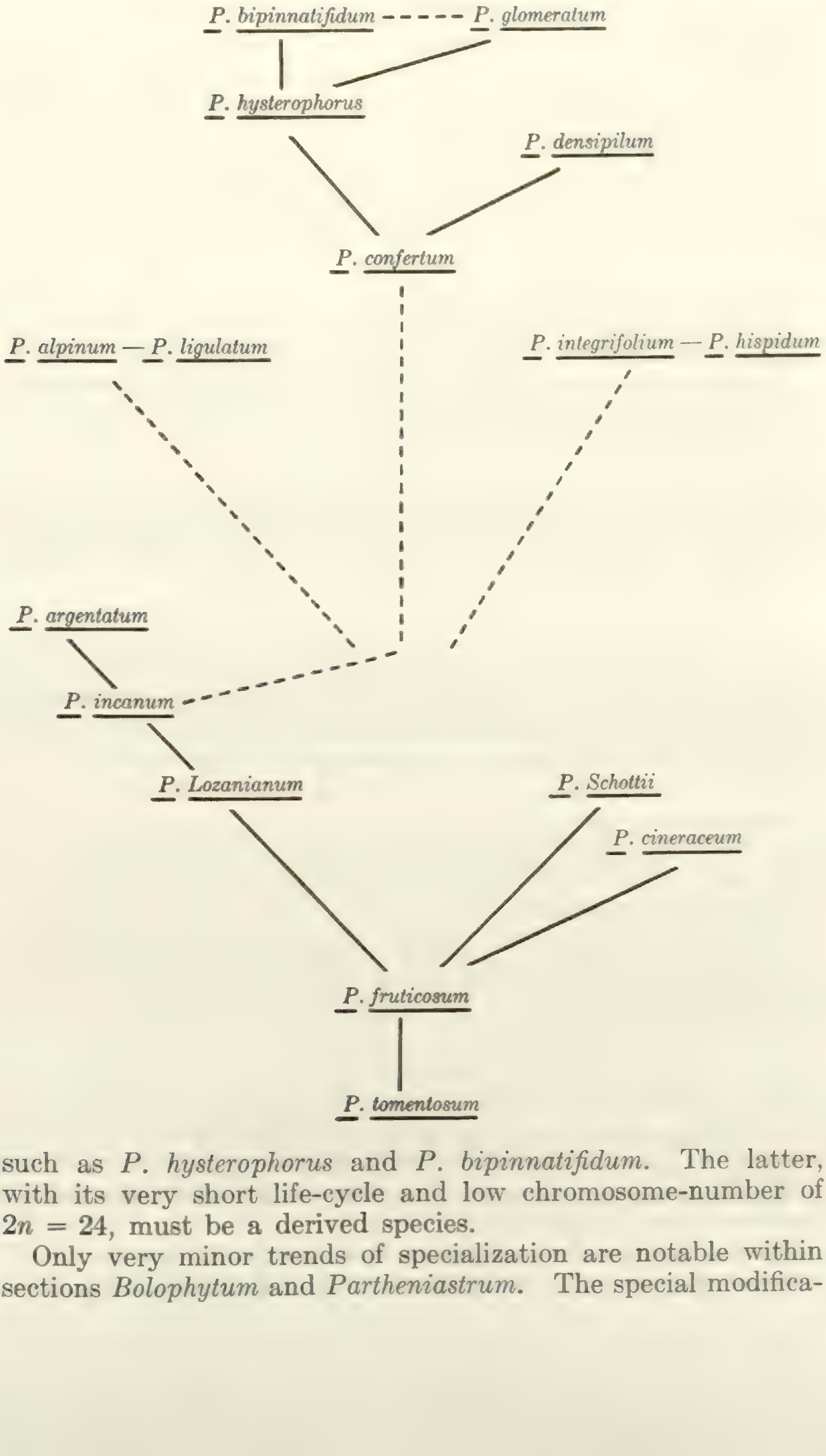
The uniformity of the inflorescence, flowers, and fruit throughout *Parthenium* strongly suggests a single phyletic group, even though the sections of the genus are rather widely different from each other. The nearly invariable five fertile ray-florets with their attached subjacent sterile disk-florets, together with a

basally fused subtending phyllary, make up a pattern that runs through the entire genus. So distinctive are these features of *Parthenium* that, as indicated above, really closely related genera in the *Compositae* appear to be non-existent. Therefore, it does not seem useful to speculate as to the ancestry of *Parthenium*, or even of its relatedness to other genera in the *Heliantheae*. But within the genus, certain phyletic trends in speciation are indicated by the assembled facts.

So far, the evidence points toward the large-leaved, highly ligneous members of section *Parthenichaeta* as being the most primitive species of the genus. *P. tomentosum* and its variety *stramonium* of this group have been quite thoroughly studied. The chromosome-number of $2n = 36$ is apparently diploid, for 18 clear bivalents are formed at meiotic metaphase. Reproduction is sexual only and there are no known complications in the reproductive process. Species of this alliance are at once the largest, woodiest, and least specialized in other characteristics of any group of species. The leaves are comparatively large and entire, with differentiated upper and lower surfaces. The branching of the corymb is uncomplicated, and bracts or bracteoles subtend each of the branches supporting the numerous heads. Trends of specialization away from these species are seen, both within section *Parthenichaeta* and in other sections of the genus. *P. tomentosum* appears to be at the most primitive end of the phyletic line. In this connection, it may be worth noting that the phyllaries almost completely surrounding the disk-florets of the achene-complex in other species merely subtend these florets in *P. tomentosum*. The trend in the genus appears to have been from that of subtending the floret to that of its complete enclosure. In this chara teristic, *P. tomentosum* stands at the primitive end of the scale. Near this species are *P. fruticosum*, *P. cineraceum*, *P. Schottii*, and *P. Lozanianum*, all showing slight specializations in one direction or another. In *P. Schottii*, the number of heads per corymb is reduced, and the heads tend to be smaller and more elongated than in *P. tomentosum*. This is accompanied by some reduction in the number of disk-florets. Specialized bulbous-based stiff and sharp trichomes are present on the upper surfaces of the leaves of *P. fruticosum*, and there is a slight tendency toward lobation of the leaves. Both *P. fruticosum* and *P. Lozanianum* are lower in stature than *P. tomentosum* and do not regularly form a trunk as in the latter species. Of the woody species of *Parthenium*, *P. argentatum* is

most specialized, both morphologically and probably physiologically. At least, with regard to the latter, it is the only species known to produce a relatively high percentage of rubber in its tissues. Aside from the fact that both polyploidy and apomixis occur in *P. argentatum*, there are a number of morphological specializations. The long naked peduncles, bearing relatively small numbers of heads congested at their apices, are unique in the genus. The peduncle itself is bractless, even though it appears to arise laterally on the stem. Actually, the inflorescence at first terminates the stem, then becomes lateral in position as the next lowest vegetative bud develops into the leader and assumes a terminal position. Other specialized features of this species are the reduced leaves that do not show marked differentiation between upper and lower surfaces, the malpighiaceous trichomes and the tendency toward root-sprouting.

It is impossible to connect the herbaceous species exactly with any of the woody ones. Quite obviously, gaps in the evolutionary lines exist between the woody and herbaceous groups and between the sections of the genus as well. Genetic evidence as to relationships across these gaps is limited to two interspecific crosses, both involving special situations. The woody *P. argentatum* and *P. incanum* were independently crossed with *P. hysterophorus*, an herbaceous annual. F_1 hybrids were produced only when non-reduction of the female gamete was followed by fertilization in the former with *P. hysterophorus* being used as the pollen parent (Rollins, 1946). The resulting "triploids" were vigorous but rather sterile. Even so, enough compatibility was shown to indicate some genetic relationship and it appears likely on these grounds that some past or present species of section *Parthenichaeta* gave rise to the primitive types of section *Argyrochaeta*. Such a line of descent requires a change from woody to herbaceous stems, yellow to white pollen, entire or nearly entire to highly divided leaves, aristate to scale-like pappus, $2n = 36$ to $2n = 34$ chromosomes, and numerous other changes of a less obvious nature. Evidently the shift from aristate to paleaceous pappus is not as striking as might be supposed. In one studied collection of *P. incanum* (Kenoyer & Crum 2621), the usual awn-like condition has been replaced by much lacerated palea-like structures. Within *Argyrochaeta*, the evolutionary pattern appears to have been from perennial species, such as *P. confertum*, var. *lyratum*, toward the annual species



such as *P. hysterophorus* and *P. bipinnatifidum*. The latter, with its very short life-cycle and low chromosome-number of $2n = 24$, must be a derived species.

Only very minor trends of specialization are notable within sections *Bolophytum* and *Partheniastrum*. The special modifica-

tions in these two groups as a whole seem to be closely associated with similar growth-characteristics found in other plant groups in similar environmental surroundings. The much dwarfed species of the *Bolophytum* group are the epitome of reduction except for head- and achene-size. These are the largest for the genus. The monocephalous plants of this group are in striking contrast to the numerous-headed corymbs of such a species as *P. tomentosum*. The single heads of *P. alpinum*, var. *tetraneuris* are pedunculate, but in var. *typicum* and in *P. ligulatum* the heads are mostly sessile. Other species of plants associated with *P. alpinum* and *P. ligulatum* are equally reduced in stature and show a similar growth-form.

The underground portions of *P. integrifolium* and *P. hispidum* are more highly developed than in the more southerly species of the genus. Thus, in *P. hispidum*, there is a strong tendency to develop a running underground root-system. In both species the basal leaves are highly developed, appearing on the root-crown early in the growing-season long before the ultimate development of the flower-bearing stems. Such characteristics are shared by many other kinds of herbaceous plants native to the middle portion of the United States. My ideas of the relationships of the species of *Parthenium* are presented in the chart that follows. The solid lines indicate definite connections between the species to which they extend. The broken lines are meant to be suggestive as to possible relationships, but there is no strong evidence available against which the suggestions may be checked.

Acknowledgements

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Systematic Treatment

In the citation of specimens, the following abbreviations have been used for the herbaria from which material was obtained: Arnold Arboretum (AA); California Academy of Sciences (CAS); Chicago Natural History Museum (CM); Dudley Herbarium of

Stanford University (DS); Gray Herbarium (GH); Instituto Lillo, Tucumán (ILT); Missouri Botanical Garden (MO); New England Botanical Club (NEBC); New York Botanical Garden (NY); Philadelphia Academy of Natural Sciences (Ph); University of California (UC); United States National Herbarium (US).

PARTHENIUM L., Sp. Pl. 988. 1753.

Argyrochaeta, Cav. Ic. IV: 54, t. 378. 1797.
Villanova, Orteg. Nov. Rar. Pl. Hort. Matr. Dec. IV: 47, t. 6. 1797.
Bolophyta, Nutt., in Trans. Am. Phil. Soc. VII: 347. 1841.

Bitter aromatic herbs or shrubs; if herbs, either caulescent or acaulescent; leaves alternate, entire to highly divided; heads small, many-flowered, inconspicuously radiate, white, borne singly or in terminal corymbs or panicles, the central portion of the head usually invested with numerous glandular and nonglandular trichomes; ray-flowers 5, pistillate and fertile, corollas and styles persistent at apex of matured achenes; disk-flowers hermaphroditic, stamens fertile, pistil sterile, the styles with a discoid apex and functional as pollen-disseminators, all disk-florets except the extreme outer row disarticulating and falling from the head together; pollen white or yellow; all florets subtended by phyllaries; phyllaries of the disk somewhat rolled and investing the florets, those of the ray-florets not rolled and broader, the outer whorl of phyllaries usually persistent; achenes obcompressed, rounded to somewhat keeled on the inner face, the margins thickened into rib-like structures which are attached to the contiguous pair of infertile florets and the subtending phyllary, the achene, two attached florets and bract falling together at maturity, achenial trichomes present; pappus of 2 to 3 awns, 2 pales or none. Lectotype-species, *P. hysterophorus* L.

ARTIFICIAL KEY TO THE SECTIONS AND SPECIES

A. Plants caulescent, herbs, shrubs or small trees up to 5 meters high; leaves alternate; heads paniculate or corymbose.
  B. Shrubs or small trees; stems woody; pollen yellow; pappus of 2–3 awns or none; heads truncate above. . Section I. *Parthenichaeta.*
    C. Inflorescence congested on a long (1–2 dm.) naked peduncle situated below the branch-apex; leaves silvery-canescent from a dense covering of appressed trichomes. . . . . 7. *P. argentatum.*
    C. Inflorescence not congested, paniculately corymbose and terminating the branches; peduncles short and bracteate; leaves tomentose to greenish but neither silvery nor with appressed trichomes.
      D. Leaves with similar or only slightly different trichomes on upper and lower surfaces; both leaf-surfaces apparently alike.
        E. Leaves whitish-tomentose with long tortuous trichomes on both surfaces, lyrately lobed, obtuse; desert shrubs; Mexico to Arizona and Texas. . 6. *P. incanum.*
        E. Leaves with short stiff trichomes, entire, acute; large shrubs; Yucatan. . . . . 4. *P. Schottii.*

D. Leaves with markedly different trichomes on upper and lower surfaces; upper and lower leaf-surfaces apparently different.
F. Upper leaf-surfaces hispidulous; each stiff pointed trichome of upper leaf-surface arising from a hemispherical mass of cells at its base.
G. Lower leaf-surfaces densely cinereous-tomentulose, blade abrupt at base, sometimes extended to form a winged petiole but not cuneate..2. *P. fruticosum.*
G. Lower leaf-surfaces hispidulous with short trichomes, blade evenly extended to form a cuneate base and winged petiole.....4. *P. Schottii.*
F. Upper leaf-surfaces softly pubescent to slightly asperulous; trichomes of upper leaf-surfaces without a half-dome-shaped base.
H. Corolla-tube constricted only at base; outer phyllaries over one-half the length of the corresponding inner phyllaries of the same head, or if shorter then acute; heads mostly broader than high; plants of Mexico.
I. Outer phyllaries acute; leaves lobed, unevenly dentate, softly pubescent below, not whitish-tomentose.....5. *P. Lozanianum.*
I. Outer phyllaries rounded; leaves entire: whitish-tomentose beneath.....1. *P. tomentosum.*
H. Corolla-tube constricted at base and at apex; outer phyllaries one-half or less in length than the corresponding inner phyllaries of the same head; heads mostly higher than broad; plants of Bolivia.....3. *P. cineraceum.*
B. Plants herbaceous; pollen white; pappus scale-like or aristate; heads slightly rounded above.
J. Pappus of 2–3 weak linear awns; leaves large, variously dentate but not lobed; heads in a flat-topped corymb .....Section III. *Partheniastrum.*
K. Leaves, stems and peduncles strongly hispid with conspicuous whitish trichomes; upper leaves auriculate; pappus-awns usually two.....13. *P. hispidum.*
K. Leaves, stems and peduncles pubescent with short inconspicuous trichomes; lower stems glabrous or nearly so; upper leaves sessile but scarcely auriculate; pappus-awns usually three.....14. *P. integrifolium.*
J. Pappus of 2 lateral pales; leaves deeply lobed to bipinnate; heads loosely paniculate on numerous fertile branches.....Section II. *Argyrochaeta.*
L. Cauline leaves lyrately lobed, not pinnate; stems several to many from base, whitish from a copious pubescence formed of large spreading trichomes.9. *P. densipilum.*
L. Cauline leaves pinnately lobed, at least the lower ones; stems one or few from base, often densely pubescent but scarcely whitish as in *P. densipilum.*
M. Heads loosely arranged in open panicles; peduncles divaricately ascending, mostly 3–10 mm. long.
N. Upper leaves and bracts pinnate, not markedly reduced upward; peduncles stout, adjacent bracts well-developed and often bilobed; pubescence of stems and leaf-veins usually of long

white trichomes much longer than those of the leaf-blades; annuals or perennials.
O. Plants biennial or perennial; basal rosette of leaves present; branching mostly above the middle, branches divaricate to strongly ascending; leaves lyrate to pinnate, rarely bipinnate.....8. *P. confertum.*
O. Plants annual; basal rosette of leaves not formed; branching from base upward, branches widely divergent; leaves bipinnate .....11. *P. bipinnatifidum.*
N. Upper leaves and bracts entire or bilobed with a linear terminal segment, leaves markedly reduced upward; inflorescence widely branching; peduncles slender, adjacent bracts much reduced to obsolete; pubescence similar on stems, leaf-veins and blades; plants annual..10. *P. hysterophorus.*
M. Heads compactly arranged in dense clusters; peduncles not divaricate, mostly 1–3 mm. long.
P. Stems prostrate to ascending, branching from base to apex; leaves pinnate to bipinnate; heads in dense separated clusters; plants annual or perennial.
Q. Plants annual; leaves punctate, especially below, from yellowish globular glands interspersed with the trichomes; plants of Mexico .....11. *P. bipinnatifidum.*
Q. Plants perennial; leaves not punctate below, glands absent; plants of southern Bolivia and northern Argentina.....12. *P. glomeratum.*
P. Stems erect, branching mostly above the middle; leaves lyrate to pinnate, rarely bipinnate; heads densely arranged, but not in separated clusters; plants biennial or perennial.....8. *P. confertum.*
A. Plants acaulescent, caespitose, less than 4 cm. high; leaves borne in tufts at the ends of fusiform caudex-branches; heads solitary.....Section IV. *Bolophytum.*
R. Ligule 1–2 mm. long; corolla-tube of ray-florets contracted above, heads sessile.....15. *P. ligulatum.*
R. Ligule entirely wanting; corolla-tube of ray-florets expanded above; heads pedunculate to nearly sessile....16. *P. alpinum.*

Section I. Parthenichaeta DC.

Parthenium, sect. II. *Parthenichaeta* DC. Prod. V: 532. 1836.

Shrubs to small trees with woody stems; heads truncate above; pollen yellow; pappus of 2–3 awns or none. Type-species, *P. incanum* H. B. K.

1. **Parthenium tomentosum** DC.

Shrub 1–7 meters high, usually with at least a short trunk at the base, often a meter or more to the lowest branches, trunk and older branches with prominent corky lenticels; branches tomentose at the extremities, glabrous or glabrescent elsewhere; leaves continuously deciduous thus concentrating the active leaves in clusters at the extremities of the branches, petiolate, blade triangular-ovate, cordate or subtruncate to

nearly cuneate at base, 4–20 cm. long, 2–10 cm. wide, whitish-tomentose beneath, greenish above but sparsely pubescent with short simple trichomes, crenate to obscurely repand; heads numerous in a relatively large paniculate corymb, densely pubescent, outer phyllaries oblong, obtuse, inner phyllaries orbicular, ciliolate; achenes black, oblanceolate to slightly broader, 2–2.5 mm. long, ca. 1.5 mm. wide, pubescent; pappus wanting; corolla white, limb 1–2 mm. long; pollen yellow; $2n = 36$.

KEY TO THE VARIETIES

Mature leaves crenate-dentate, loosely pubescent beneath, bracts of the outer inflorescence prominent, Oaxaca and Puebla. 1a. var. *typicum*.
Mature leaves obscurely repand, closely pubescent beneath, bracts of the outer inflorescence reduced, Chihuahua and Sonora ..... 1b. var. *stramonium*.

1a. **Parthenium tomentosum** DC., var. **typicum.**

P. tomentosum DC. Prod. V. 532. 1836.

Known from Puebla and Oaxaca. Representative specimens:—**PUEBLA:** Tlacuiloltepec, *Purpus 3832* (GH, NY, UC); El Riego, Tehuacán, *Conzatti 2147* (CM); limestone hills near Tehuacán, *Pringle 9384* (GH, MO, NY, US); Tehuacán, *Purpus 5901* (GH, NY, UC, US). **OAXACA:** between Oaxaca and Mitla, *Andrieux 281* (CM, photo of type; GH, fragment of type); Atatlanca, *Smith 349* (GH); La Hoja Cañon, *Pringle 5652* (GH, MO); Cuicatlán, *Rusby 71* (NY, US); Cuicatlán, *Nelson 1697* (GH, US); Santa Catarina, *Rusby 99* (NY, US); grown from seed collected by H. S. Gentry 16–18 kilo. above Tomellín, near Almoloyas, *Rollins 3133* (DS); Monte Albán, near Oaxaca, *Smith 354* (MO, US); same locality, *Pringle 4952* (GH, MO, NY, Ph, UC, US); Alturas de Matatlán, Tlacolula, *Conzatti and Vasquez 1489* (CAS, GH).

1b. **Parthenium tomentosum** DC., var. **stramonium** (Greene) comb. nov.

P. stramonium Greene, Pitt. 4: 240. 1901.
P. arctium Bartlett, Proc. Amer. Acad. 44: 635. 1909.

Chihuahua and Sonora. Specimens examined:—**CHIHUAHUA:** Hacienda San Miguel, *Palmer 123* (GH, type; NY, Ph, isotypes of *P. arctium*); near Chuichupa in the Sierra Madres, *Townsend and Barber 393* (GH, MO, NY, UC, isotypes); El Limon, Rio Mayo, *Gentry 1539* (AA, CM, MO, Ph, UC, US). **SONORA:** Higuera, near Moctezuma, *White 393* (GH); canyon in mountains west of Rio de Sonora, Baviacora, *Drouet et al. 3621* (CM, DS); gorge in andesitic rock, 23 miles south of Divisadero, *Wiggins 7496* (AA, DS, UC, US); 6 miles south of Cedros, *Wiggins 6436* (DS, UC, US); 6–8 mi. south of Cedros on road to Quiriego, plants grown from seed coll. by H. S. Gentry, *Rollins 3134* (DS); between Cedros and Quiriego, *Shreve 6175* (CM, NY, US); Las Durasnillas, May, 1892, *Brandegee s. n.* (UC); La Tinaja, *Hartman 248* (GH, US).

Crossing experiments (Rollins, 1946) have demonstrated that there are no major genetic incompatibilities between var. *typicum*

and var. *stramonium*. The F_1 progenies of reciprocal crosses are highly fertile and normal seed-set is apparently unimpaired. The morphological similarity of the two varieties is unmistakable. Some specimens of branch-tips and flower-clusters from Puebla could easily pass for var. *stramonium* although a close study shows that they possess the few distinctive features of var. *typicum*. These facts and observations point to the desirability of associating var. *typicum* and var. *stramonium* within a single species rather than maintaining them as distinct species. Bartlett (l. c.) pointed to the lack of leaf-like bracts subtending the larger branches of the inflorescence as being distinctive for the entity here treated as var. *stramonium*. He also presumed that the inflorescences were exceeded by the leaves in var. *stramonium* while not in var. *typicum*. My observations on living material and a number of herbarium specimens are not in accord with these presumptions. Rather, there is considerable variation present in both var. *typicum* and var. *stramonium* and no definite line of demarcation separates them.

The plants of both var. *typicum* and var. *stramonium* used for experimental purposes were grown from seeds collected by H. S. Gentry. From his relatively detailed field-notes the following useful word picture of var. *stramonium* growing near Cedros, Sonora, has been extracted. The plants "range from 2 to 7 meters depending primarily upon the age and the largest could be called small trees. A definite trunk is formed, 2 to 4 inches in diameter, unbranched for 2 to 4 feet when the branches diverge out and up at a sharp angle to form a spreading flattish crown. The bark is dark brown, regularly and characteristically furrowed. A clear white resinous gum is exuded from injuries." Variety *stramonium* "is most successful around the rancho called Escondido or Doliso where it is mixed with the higher forest trees and displaces nearly all of the other competing shrubs such as *Croton*, *Brongniartia*, *Acacia*, etc. Here the plants are spaced rather regularly from a few to many feet apart forming a light grayish distinctive shrub cover. The plant has two names locally. *Otatillo* is the one more generally used; the same as given for the plant in the Chihuahua barrancas. *Huasaraco* is a name given it by a small black man, who came by with two burros while we were collecting seed. This latter is undoubtedly the older Indian term from one of the Gajitan subtribes that earlier inhabited the Cedros valley. Medicinal properties were ascribed to the heart wood, both by the little black fellow and by

townsmen in Quiriego. It is ground finely and a decoction made in water as a potion for stomach ailments and for rheumatism." At a later date, when Dr. Gentry collected seeds from var. *typicum*, he noted that, in habit and general appearance, it was very close to var. *stramonium*.

2. **Parthenium fruticosum** Less.

Shrub, recorded height up to 4 meters; branches sparsely arachnoid-tomentose, glabrate; leaves triangular-ovate, repand to crenate-dentate, sometimes obscurely three-lobed, petiole 1–3 cm. long, free or winged near blade, blade abrupt at base, rarely with a few lobes on the petiole, 4–10 cm. wide, 6–15 cm. long, roughly hispidulous with tuberculate-based trichomes above, cinereous-tomentulose beneath; heads numerous in a paniculate corymb 8–15 cm. broad, sordidly pubescent, outer phyllaries suborbicular, pubescent, short-ciliate, rounded, less than 2 mm. long; inner phyllaries orbicular, membranaceous, ciliolate, 3–4 mm. long; rays white, erect, emarginate, ca. 1 mm. long, tube strongly constricted at both top and bottom; achenes obcompressed, oblanceolate, black, 1.5–2 mm. long, 1–1.3 mm. wide, pubescent; pappus none, 1, 2 or 3 aristate awns, these up to nearly 1 mm. in length, or more often much reduced if present. $2n = 36$.

Key to the Varieties

Leaves not lobed; blade more or less irregularly decurrent on the petiole but not terminating abruptly in paired lobes.....2a. var. *typicum*.
Leaves trilobate, the lobation less pronounced toward the ends of the branches; blades strongly decurrent forming a petiole-wing which terminates abruptly in paired lobes.....2b. var. *trilobatum*.

2a. **Parthenium fruticosum** Less., var. **typicum.**

P. fruticosum Less., ex Schlechtendal and Chamisso, in Linnaea V: 152. 1830.
P. parviceps Blake, in Contrib. U. S. Nat. Herb. 22: 607. 1924.

Tamaulipas and San Luis Potosí to Chiapas, Mexico. **TAMAULIPAS:** Chamal, *Kenoyer & Crum 3645* (GH); 9 miles east of Monte, *Kenoyer & Crum 3679* (GH). **SAN LUIS POTOSI:** Valles (Xilitla?) *Kenoyer A170* (CM, MO); 12 mi. east of Valles, *Kenoyer & Crum 3866* (GH); between Valles and V. Juarez, *White 3* (CM); 0.5 km. south of Tamaulipas State line, Pan. Am. Highway, *Norvell* s. n. (GH). **VERA CRUZ:** Plan del Rio (Vera Cruz?) *Schiede 334* (GH, tracing and fragment of type); Zacuapan, *Purpus 7857* (UC); Barrancas near San Martin Tlacotepec, Zacuapan, *Purpus 7757* (AA, UC); Barranca de Tenampa, Zacuapan, *Purpus 1849* (US, type; GH, MO, UC, isotypes of *P. parviceps*); Palmar, *McDaniels 913* (CM). **CHIAPAS:** between San Richardo and Ocozucuantla, *Nelson 2965* (GH, US).

2b. **Parthenium fruticosum** Less., var. **trilobatum,** var. nov.

Foliis trilobis in petiolum decurrentibus. Similar to var. *typicum* except for the trilobate leaves and decurrent blades forming a winged petiole. **TAMAULIPAS:** vicinity of Marmolejo, Sierra de San Carlos, Aug. 11, 1930, *H. H. Bartlett 10898* (US, type); about 4 km. south of La Encantada, *James Hinton 16840* (GH).

A careful examination of all the material available shows that the presence or absence of pappus-awns is not a reliable criterion for segregating *P. parviceps*. Florets from some specimens consistently possess two awns while those from others have a single awn or none. In one specimen, *White No. 3*, collected between Valles and V. Juarez, the achenes possessed a third ventral awn in addition to the two lateral. Otherwise all the material here placed in *P. fruticosum* falls within a consistent morphological pattern. The specimens of the type-series of *P. parviceps* look a little different in general aspect from other material of *P. fruticosum*, but other specimens collected by Purpus in the same area do not appear distinctive in any way.

P. fruticosum is readily distinguishable from *P. tomentosum*, but it is possible that these species have hybridized at some period during their history. At least, specimens of *Nelson No. 1697* from Cuicatlan, Oaxaca, which are like *P. tomentosum* in most respects, have some characteristics of *P. fruticosum*. The presently known range of *P. fruticosum* does not include Oaxaca, but thorough data concerning the species-range are not available.

One of the most distinctive and readily seen characters in *P. fruticosum* is the bulbous mound of cells at the base of each trichome on the upper surfaces of the leaves. These cells have differentiated somewhat from the ordinary adjacent epidermal cells, having enlarged considerably and, upon maturity, lost their living contents. These cells, out of which the elongated portion of the trichome arises, are interpreted as being an integral portion of the trichome. They often form a large enough mass to be seen as a whitish dot in contrast to the darker leaf-surface.

Variety *trilobatum* shows a trend in the direction of *P. Lozanianum*, but it has larger, less-divided leaves, smaller heads with shorter, broader outer phyllaries and prominent, bulbous-based trichomes on the upper leaf-surfaces. In these respects it agrees quite well with typical *P. fruticosum*. However, my conclusions as to the status of *P. Lozanianum* and *P. fruticosum* var. *trilobatum* should be considered tentative, since there is only a single

collection of the former available for study. Considerable field-work is needed to provide sufficient material for study before a clear understanding of these plants can be obtained.

P. fruticosum has been in cultivation for only a short time and has not been used in breeding-experiments. The chromosome-number $2n = 36$ fits into the pattern for the majority of species in *Parthenium* and is probably on the diploid level. Judging from the variability among seedlings produced from wild individual plants, *P. fruticosum* is probably a sexual species. In this respect, its breeding-behavior should be similar to that of *P. tomentosum*.

3. **Parthenium cineraceum** Rollins, sp. nov.

Woody, shrub or small tree (?); bark greyish, longitudinally striate; branches cinereous, densely pubescent; leaves alternate, triangular, obtuse to acute, unevenly crenate to almost lobed, blade abruptly narrowed at base, 6–12 cm. long, 3–5 cm. wide, slightly decurrent on the petiole, densely whitish-tomentose below with tortuose trichomes, felt-like to the touch, pubescent with short erect trichomes above, mid-vein prominent, petiole 1.5–3 cm. long, infrequently somewhat winged; inflorescence paniculately corymbose, 6–10 cm. across, lower branches with well-developed bracts 1–2 cm. long, bracts becoming much reduced toward extremities; heads longer than broad, outer phyllaries 5, densely pubescent, lower 2 broadly oblong, smaller than the next 3 above which are triangular-ovate; inner phyllaries subtending and attached at base to ray-florets, orbicular, ciliolate above, ca. 3 mm. long; rays white, nearly tubular to slightly flaring, usually erect, ca. 1.5 mm. long; corolla-tube strongly constricted above and below; style exserted, stigma-lobes slightly less than 1 mm. long; achenes black, obcompressed, not ribbed, narrowly oblanceolate, tapered to a point at base, ca. 3 mm. long, ca. 1.2 mm. wide; pappus none, 1 or 2 very weak lateral awns; disk-florets subtended by hooded paleaceous bracts, shorter than the ray-florets. Plate I.

Planta fruticosa; caulibus teretibus striatis pallide griseis, ramis pubescentibus; foliis alternis petiolatis triangularibus obtusis vel acutis, laminis supra brunneo-puberulis subtus albo-tomentosis 6–12 cm. longis, 3–5 cm. latis; petiolo 1.5–3 cm. longo; inflorescentia adscendenter ramosa corymboso-paniculata; pedicellis brunneis gracilibus pubescentibus; involucri squamis 2-seriatim imbricatis valde inaequalibus late oblongis vel orbicularibus ciliolatis ca. 3 mm. longis; corollis albis; achaeniis nigris pubescentibus obcompressis ca. 3 mm. longis, ca. 1.2 mm. latis.

BOLIVIA: La Cuesta (Calzas), Santa Cruz, prov. Cordillera, 415 meters, Ja. 29, 1945, *G. Peredo 98* (Type, ILT; fragment at GH).

Previous to the present study, the genus *Parthenium* had not been certainly known to be native to South America. *P. hysterophorus* is widely distributed as a probable introduction in central

Photograph of the type of *Parthenium cineraceum*.

and northern Argentina and adjacent areas, while a relative of this species, *P. glomeratum*, from high altitudes in Bolivia and adjacent Argentina, was thought to be introduced also. In fact, the latter has most often been labeled *P. hysterophorus*. The discovery of *P. cineraceum* from Bolivia, a member of section *Parthenichaeta*, removes all possible doubt that *Parthenium* does occur natively in South America. *P. cineraceum* is most closely related to *P. fruticosum*, from which it is distinguished by a number of technical characters. The most readily observable difference is in the trichomes of the upper leaf-surfaces. In *P. fruticosum*, pointed stiff curved trichomes surmount a hemispherical mound of whitish cells, producing a hispidulous surface. The trichomes of *P. cineraceum* do not have an enlarged base and the upper leaf-surface is rather soft to the touch. The achenes of the latter species are larger, being at least a millimeter longer, and more tapering above than those of *P. fruticosum*. The heads of the two species are similarly constituted, but those of the latter are smaller than in *P. cineraceum*. The subjacent florets are shorter than the ray-florets in the latter, but equal or exceed the ray-florets in *P. fruticosum*.

4. **Parthenium Schottii** Greenman ex Millspaugh and Chase

Parthenium Schottii Greenman ex Millspaugh and Chase, Field Mus. Pub. Bot. III: 109. 1904.

Shrub 1–4 meters high, trunk up to 25 cm. in circumference; branches sordidly pubescent near their extremities, glabrate, shallowly striate; leaves triangular-ovate to narrower, petiolate, blade entire to very shallowly crenate, sparsely pubescent above with tuberculate-based trichomes, slightly asperulous, more densely pubescent below with non-tuberculate pointed trichomes, not asperulous below, blade evenly decurrent on the petiole forming a cuneate base and winged petiole, leaves 2–6 cm. wide, 7–12 cm. long, petiole 1–2 cm. long; heads numerous, corymbose, fewer than in *P. fruticosum*, 3–4 mm. high, 3–4 mm. broad; outer phyllaries elliptical, pubescent, 1–1.5 mm. long, inner phyllaries suborbicular to broadly elliptical, pubescent toward apex at back, 2.5–3 mm. long; achenes narrowly obovate, pubescent especially on the back and ventral ridge, 2–3 mm. long, 1–1.3 mm. wide; pappus of 2 or 3 minute spreading to recurved awns, ventral awn sometimes absent; corolla-tube narrow, constricted below and at apex, ray ca. 1 mm. long, white.

Yucatán, Mexico. Specimens examined:—**YUCATAN:** Progreso, *Gaumer 1166* (CM, type; AA, CAS, GH, MO, US, isotypes); Progreso, *Millspaugh 1165* (CM); Progreso, *Steere 2999* (US); south of Cienaga, Progreso, *C. L. & Amelia A. Lundell 7948* (GH); road from Progreso to Merida, *R. S. Flores s. n.* (CM); Labcah, *Schott 264* (CM); San Anselmo,

Gaumer 2115 (CM); Calotmul, *Gaumer 2213* (AA, CAS, CM, GH, MO, US).

This species is most closely related to *P. fruticosum*, but is distinct from that species morphologically and is separated from it geographically. Easily observable differences are those of pubescence, leaf-shape and size, and the comparative sizes of the outer and inner phyllaries. The pubescence of the lower leaf-surface in *P. Schottii* consists of short, pointed trichomes, whereas that of *P. fruticosum* is arachnoid-tomentose. The latter species has larger leaves which lack the cuneate base found on the leaves of *P. Schottii*. The heads of *P. Schottii* tend to be more cylindrical than turbinate while in *P. fruticosum*, the tendency is toward a turbinate shape.

P. Schottii is illustrated on a full page opposite page 110, l. c. and the details of the fruit and fruit-complex are given on page 110. It should be noted that the illustrations on that page intended as those of *P. fruticosum* are actually those of *P. Schottii*, having been taken from *Millspaugh 1665*. The importance of the number of pappus-awns has been unduly emphasized in *Parthenium*. The pappus is much reduced in *P. Schottii* and the fact that the ventral awn is sometimes entirely absent does not appear to be taxonomically significant.

5. **Parthenium Lozanianum** Bartlett

Parthenium Lozanianum Bartlett, Proc. Amer. Acad. 44: 636. 1909.

Shrub 1–2.5 meters high; branches lightly pubescent to glabrous, shallowly striate; leaves petiolate, more or less triangular or deltoid-ovate, 4–10 cm. long, 2–5 cm. wide, coarsely repand-dentate with blunt teeth, usually with a pair of small lobes below the base of the blade, densely pubescent below with simple tortuous trichomes, sparsely pubescent above with short, simple trichomes; heads numerous in an open paniculate corymb which terminates the branches; outer phyllaries ovate, acute, lightly pubescent or glabrous, inner phyllaries nearly orbicular, glabrous; achenes black, oblanceolate, glabrous, 2–2.5 mm. long, ca. 1.5 mm. wide pappus-awns 2, originating at the juncture of the achene and corolla-tube, incurved, ca. 1 mm. long; corolla white, limb not prominent, tube ca. 1 mm. high, limb less than ca. 1 mm. long.

Known only from the type-collection: limestone ledges, Hacienda, El Carrizo (on maps as Carrizal, a town southeast of Linares), (Sierra Madre above Monterrey?) Nuevo León, Mexico, May 1, 1906, *Filemon L. Lozano 10247* (GH, type).

There are certain specimens treated as *P. incanum*, which have characters tending toward *P. Lozanianum*. This material may

actually be of hybrid origin involving introgression from *P. Lozanianum* into *P. incanum*. Though nearest to *P. incanum*, these plants attest to the relatedness of the two species which would also be inferred on morphological grounds. *P. Lozanianum* lacks the third pappus-awn present on the ventral side of the achenes of *P. incanum*. Also, as noted by Bartlett, the pappus-awns of the former are incurved or at least stiffly erect whereas they are spreading to recurved in the latter. Actually, the short thickened trichomes found on the upper surfaces of the leaves of *P. Lozanianum* are distinctive compared to the long tortuous ones of *P. incanum*. The leaves of this species are much too large for *P. incanum* and begin to approach *P. fruticosum* in this respect. In my opinion, *P. Lozanianum* is more closely related to *P. fruticosum*, var. *trilobatum* than to *P. incanum*. In fact, var. *trilobatum* is somewhat intermediate between typical *P. fruticosum* and *P. Lozanianum*, and could itself easily be of hybrid origin.

The printed data on the label of the type-specimen are conflicting in some respects. On one line appears, "Hacienda, El Carrizo, 1,000 ft." and on the second line below, one reads, "Limestone ledges, Sierra Madre above Monterrey, 3,000 ft." This is a label of C. G. Pringle, whose Mexican helper, Lozano, made the collection. It has been of some importance to re-collect and to obtain seeds of this species for breeding-purposes. To this end, Mr. James Hinton of Saltillo has spent some effort in attempting to locate *P. Lozanianum* in the area near Monterrey. His lack of success is probably due to the fact that this plant does not grow near Monterrey, contrary to some of the data on the label. We find by studying the chronicle of Pringle's collecting activities, by Davis (1936), that El Carrizo is on most maps as Carrizal and is located a few miles southeast of Linares, which in turn is nearly to the southern border of Nuevo León, and at some distance from Monterrey. Carrizal, the type-locality of *P. Lozanianum*, is not in the Sierra Madre proper, and is at about 1000 feet elevation. Thus it appears the data, "Limestone ledges, Sierra Madre above Monterrey, 3000 ft.," are erroneous.

There are two sheets of the type-collection in the Gray Herbarium, but I have not seen specimens of the same set in other American herbaria. This is somewhat surprising since under the date of May 1, 1906, in Pringle's diary (Davis, 1936, p. 233) we find the statement, "Filemon returns bringing a fine set of 10247

Parthenium lozanoanum Bart. n. sp." It is obvious to infer that more than two specimens were collected, but what happened to the bulk of them is unknown.

6. **Parthenium incanum** H. B. K.

Parthenium incanum H. B. K. Nov. Gen. et Sp. IV. 260 t. 391. 1820.
P. ramosissimum DC. Prod. V. 532. 1836.

Aromatic shrub, 4–10 dm. high, intricately branched beginning near base, often with several stems from the base after the first year's growth; branches cottony-pubescent with long simple trichomes, glabrate; leaves mostly lyrate, broadly oblong to obovate, short-petioled, lobed, sometimes deeply so, lobes rounded, densely cinereous-tomentose below, with long simple trichomes, pubescence similar but less dense above, sometimes greenish above, 1–6 cm. long, 0.5–2 cm. wide; heads several to many in spreading corymbs terminating each branch, flat-topped, densely pubescent, 3–5 mm. broad; outer phyllaries oblong, acute, densely pubescent: inner phyllaries suborbicular, membranaceous, densely pubescent above; rays white, emarginate to more deeply incised, 1–2 mm. long; tube short, pubescent on outer surface; achenes black, oblanceolate, 1.5–2 mm. long, ca. 1.5 mm. wide, pubescent especially on the ventral surface with loose-elongated trichomes; pappus of two lateral divergent to erect pubescent awns and a weaker erect ventral awn, ventral awn sometimes absent. Texas to Arizona, south to Hidalgo and Querétaro and Mexico, D. F. Fig. 13.

TEXAS: Bronte, Coke Co., *Palmer 11163* (CAS, GH, MO); high limestone hills, San Angelo, Tom Green Co., *Palmer 11151* (AA, DS, GH, MO, US); 4 mi. south of Crane, Crane Co., *Tharp s. n.* (GH, MO); Fort Stockton, Pecos Co., *York 271* (DS); 50 miles west of Sanderson, Terrell Co., *Hitchcock and Stanford 6796* (UC); southeast of Sanderson, Terrell Co., *Rollins 3104* (DS); Rio Grande, Starr Co., *Runyon 5* (GH); Pecos, Reeves Co., *Kiltz K-891* (GH); Davis Mts. Limpia, Jeff Davis Co., *Hanson 754* (GH); North side of Chisos Mts., Brewster Co., *Moore and Steyermark 3285* (DS, GH, MO, UC); 02 Ranch, central Brewster Co., *Rollins 3103* (DS); San Esteban Lake, Presidio Co., *Hinckley s. n.* (GH); 1.5 miles south of Shafter, Presidio Co., *Rollins 3102* (DS); 1 mi. south of the Texas-New Mexico line on highway 62, Culberson Co., *Waterfall 3780* (GH); below McKittrick Canyon, Guadalupe Mts., Culberson Co., *Moore and Steyermark 3610* (CAS, DS, GH, MO, UC); vicinity Ft. Quitman, Hudspeth Co., *Waterfall 3995* (GH, MO); El Paso, *Schulz 208* (GH). **NEW MEXICO:** Santa Rosa, Guadalupe Co., *Arsène 16701* (CM); 1 mile west of Acme, Chaves Co., *Waterfall 6128* (GH, MO); 15 mi. south of Carlsbad, Eddy Co., *Waterfall 3731* (GH); Lincoln, Lincoln Co., *F. A. and E. S. Earle 238* (GH, MO); 15 mi. east of Capitan, Lincoln Co., *Hitchcock et al. 4245* (DS, GH, UC); Sacramento Mts., Otero Co., *Rehder 395* (GH); Nogales Canyon, San Mateo Mts., Socorro Co., *Pilsbury s. n.* (Ph); near

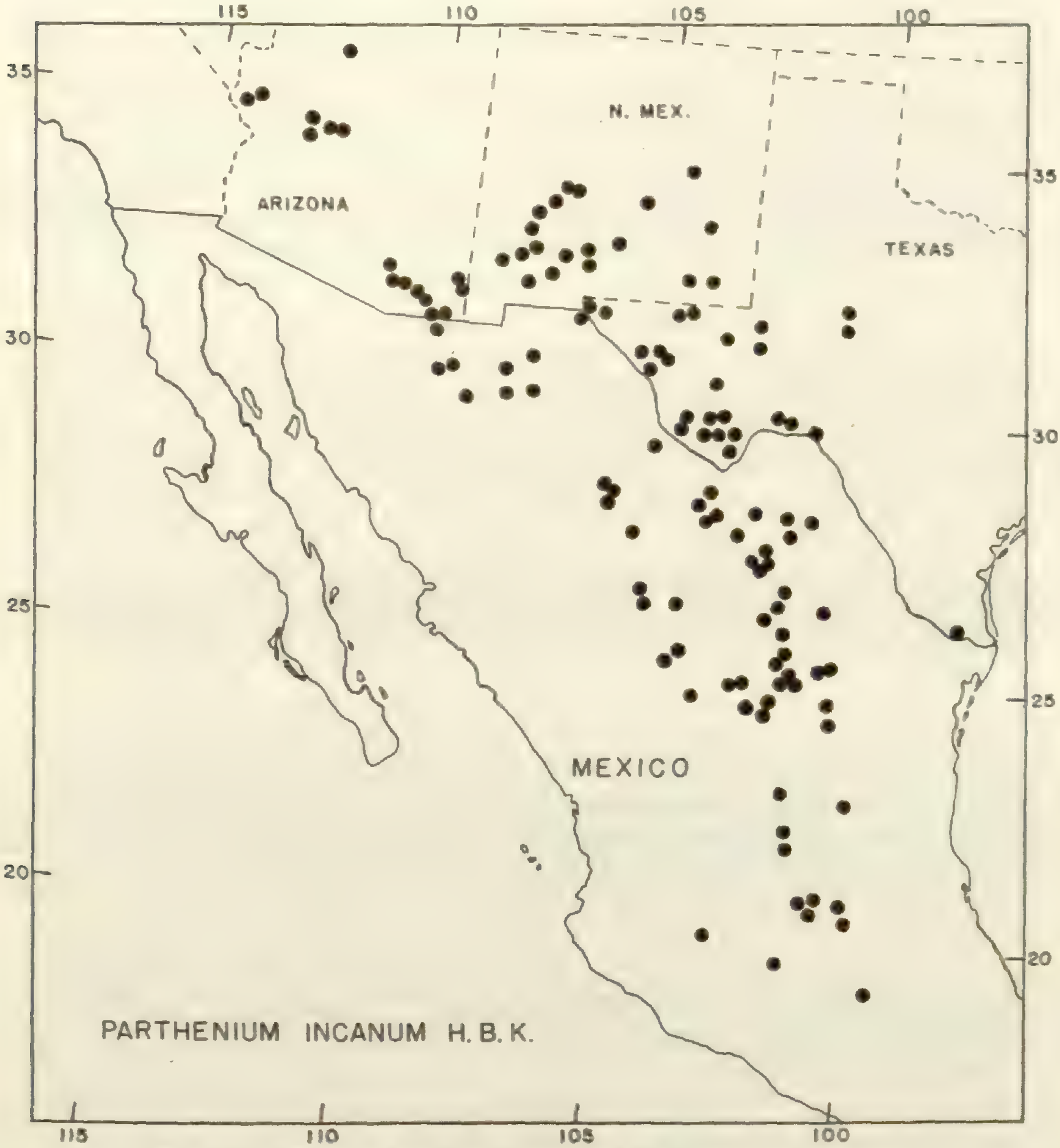

Fig. 13. Geographic distribution of *Parthenium incanum.*

Socorro, Socorro Co., *Rollins 3105* (DS); Water Canyon, Magdalena Mts., Socorro Co., *C. J. and R. Herrick 16* (CM); Organ Mts., Dona Ana Co., *Wooton 116* (DS, GH, MO, UC); mesa west of the Organ Mts., Dona Ana Co., *Wooton and Standley 3194* (DS, MO); Trujillo Creek, south end of Black Range, Sierra Co., *Metcalfe 1359* (CAS, GH, MO, UC); Mangas Springs, 18 mi. northwest of Silver City, Grant Co., *Metcalfe 649* (GH, MO). **ARIZONA:** Outlaw Canyon, Chiricahua Mts., Cochise Co., *Goodding 2347* (GH, UC); Portal, Cochise Co., *Eggleston 10921* (GH, UC); Benson, Cochise Co., *M. E. Jones 25070* (GH, UC); Douglas, Cochise Co., *Goodding 2390* (GH, UC); near Tucson, Pima Co., *Peebles and Kearney*

8731 (GH); Vail, Pima Co., *Thornber 104* (DS, UC); Ft. Whipple, Yavapai Co., *Coues and Palmer 572* (GH, MO); Cornville, Yavapai Co., *W. W. Jones s. n.* (UC, US); near Kingman, Mohave Co., *Braem 855* (AA, DS); Hermit Trail, Grand Canyon, Coconino Co., *Eastwood 5870* (AA, CAS). MEXICO.—**CHIHUAHUA:** near Juarez, *Pringle 9943* (GH); near Lake Santa Maria, *Nelson 6408* (GH); near Casas Grandes, *Hartman 809* (GH, UC); near El Carmen, *LeSueur 446* (CM); hills near Chihuahua, *Pringle 996* (DS); near Jimenez, *Juzepczuk 628* (CM). **SONORA:** 6 miles east of Agua Prieta, *White 3838* (GH); Bavispe, *White 2855* (DS, GH). **COAHUILA:** Sabinas, *Nelson 6802* (GH); 4 miles east of Cuatro Cienegas, *Johnston 7115* (GH); eastern foothills of the Sierra de las Cruces, *Stewart 246* (GH); 43 miles south of Monclova, *Kenoyer and Crum 2621* (GH); 9 km. south of Parras, *Stanford et al. 175* (DS, GH, MO); near Saltillo, *Palmer 58* (GH, NY, UC). **NUEVO LEON:** Sabinas Hidalgo, *C. H. and M. T. Mueller 272* (AA, CM); Monterrey, *Hinton 16719* (GH); Lampazos, *Edwards 395* (CM); Las Trancas, Municipio de Rayones, *Mueller 2165* (AA, CM, MO); between Doctor Arroyo and Mathuala, S. L. P., *Nelson 4525* (CM). **DURANGO:** 71 km. west of Bermejillo, *Gentry 6838* (GH); between Mapimi and Guajuquilla, *Gregg 485* (GH, MO). **ZACATECAS:** Hacienda de Cedros, *Lloyd 128* (MO, UC); 40 miles NW of Catorce, *Rollins 3101* (DS, GH). **SAN LUIS POTOSI:** Charcas, *Whiting 862* (CM); Mt. San Miguelito, in the vicinity of San Luis Potosí, *Schaffner 231* (GH, US); San Luis Potosí, *Berlandier 1342* (GH, MO, isotypes; CM, photo. of type of *P. ramosissimum* DC); region of San Luis Potosí, *Parry and Palmer 434* (GH, MO). **QUERETARO:** near Higuerillas, *Rose et al. 9775* (GH, US); between Higuerillas and San Pablo, *Altamirano s. n.* (US; not typical, possibly of hybrid origin); between San Pablo and Cadereyta, *Rose et al. 9830* (GH, US; not typical, possibly of hybrid origin). **JALISCO:** Lake Chapala, *Lemmon 96* (GH). **HIDALGO:** Ixmiquilpan, *Purpus 1343* (GH, MO. UC). Ixmiquilpan, *Rose et al. 9033* (GH, US; not typical, possibly of hybrid origin); Zimipan, *Kenoyer A169* (CM, not typical, possibly of hybrid origin). **MICHOACAN:** Morélia, *Arsène s. n.* (CM). **MEXICO:** mountains in the vicinity of Mexico, Aug., 1827, *Berlandier 632* (GH).

P. incanum is nearest related to *P. argentatum*, but the two species are well separated morphologically and it is only in cases where hybrids between the species are involved that the identity of given material may be in doubt. The range of *P. incanum* is greater than that of *P. argentatum* in nearly all directions, particularly to the northeast, northwest and south, but the two species are together over a wide area in northeastern Mexico and adjacent southwestern Texas. It reaches its extreme northern limit in the Grand Canyon of Arizona.

There is considerable variation within *P. incanum* when the

species is viewed as a whole. Part of this is the result of hybridization with other species, but a portion of the variation found cannot be attributed to that source. Plants growing in areas where no contact with other species of *Parthenium* is possible show discontinuous differences which appear remarkably constant. The maintenance of these constant distinct minor entities is probably due to apomixis. How these differences arose, initially, is less certain. However, it seems reasonable to assume that the presently known apomictic lines came originally from various points in the total variation of the species. If this be the case, then any part of the variation present in the sexual phase of the species might be expected to show up approximating a fixed line reproducing apomictically. Particularly puzzling material of *P. incanum* comes from the vicinity of Monterrey and towards Monclova in Coahuila. These specimens have larger, less divided leaves than are commonly found in the species, and the upper leaf-surfaces are less densely pubescent. Also, the achenes lack the ventral awn more frequently than appears to be the rule in the species as a whole. However, I have not found valid characters for separating these populations taxonomically. Such collections as *Hinton No. 16719* and *Kenoyer and Crum No. 2621* show the characters referred to.

Both apomixis and a modified type of sexuality are known to occur in *P. incanum* but, unfortunately, there are not enough data available to reveal the prevalence and extent of each. The available data show that apomixis is present in plants from several stations in Texas, one station in New Mexico, one in Arizona, and one in the state of Zacatecas, Mexico. From this, it is inferred that apomixis is widespread in the northern portion of the species-range. No data on the types of reproduction are available on plants from the southern part of the species-range. However, it is evident that *P. incanum* hybridizes with other species of *Parthenium* southward more freely than elsewhere. The role of this species in hybridizing introgressively with *P. argentatum* has been the subject of a special paper (Rollins, 1949).

In the southern portion of its range, *P. incanum* has not been collected frequently enough to show a continuous pattern of distribution. Furthermore, as indicated under the citations of specimens, several of the available collections show deviating characteristics that may be of hybrid origin. Another possibility is that a primitive portion of the species, that gave rise to the more widespread types, is represented in the most southerly

portion of the range. So far, the material from this area has been too meagre to piece together a plausible explanation for deviating characteristics observed. The one record from the State of Mexico, *Berlandier 632*, has not received substantiation by more recent collections. This raises some doubt as to whether the collection, so labeled, actually came from there.

7. **Parthenium argentatum** Gray

Parthenium argentatum Gray in Torr. Bot. Mex. Bound. II. 86. 1859.
P. argentatum, var. *angustifolium* Nicolaieff, Bull. Appl. Bot., Genetics and Pl. Breed. 22 (4): 252, fig. 34 & 35. 1929.
P. argentatum, var. *brevifolium* Nicolaieff, ibid. p. 258, fig. 40 & 41.
P. argentatum, var. *deltoideum* Nicolaieff, ibid. p. 266, fig. 47.
P. argentatum, var. *dissectum* Nicolaieff, ibid. p. 265, fig. 46.
P. argentatum, var. *gracile* Nicolaieff, ibid., p. 268, fig. 48.
P. argentatum, var. *latifolium* Nicolaieff, ibid. p. 262, fig. 43 & 45.
P. argentatum, var. *longifolium* Nicolaieff, ibid. p. 256, fig. 36 & 38.
P. argentatum, var. *marioloides* Nicolaieff, ibid. p. 247, fig. 29–33.
P. Lloydii Bartlett, Torreya 16: 46. 1916.

Shrub, 3–10 dm. high, intricately branched beginning just above the base, extremities of branches silvery-canescent; leaves long-petioled, silvery-canescent due to a dense covering of appressed malpighiaceous trichomes, spatulate to narrowly oblanceolate, acute to acuminate, 2–6 cm. long, 0.5–2 cm. wide, entire to several-toothed, teeth acute; peduncles 1–2 dm. long, naked or with a single bract; heads several to many in small corymbs or corymbose panicles, short-pediceled; outer phyllaries oblong to ovate, opaque, densely pubescent; inner phyllaries nearly transparent, membranaceous, suborbicular, glabrous except for a fringe of simple trichomes above; rays dull to creamy white, shallowly emarginate to rather deeply cleft, 1–2 mm. long; tube pubescent on outer surface; achenes obovate, black, lightly to fairly densely pubescent above on both surfaces with very short trichomes 2–3 mm. long; pappus of three erect to slightly spreading pubescent awns, lateral pair about equal, ventral awn weaker. Western Texas to Chihuahua and Hidalgo. Fig. 14.

TEXAS: near Escondido Creek, Sept., 1852, *J. M. Bigelow 83*[1] (GH, type); southeast of Sanderson, Terrell Co., *Rollins, 3097* (DS); 20 mi. east of Fort Stockton, Pecos Co., *Rollins 3124* (DS); west of Fort Stockton, Pecos Co., *Jones 28027* (DS, MO, UC); about 19 mi. east of Balmorhea, Reeves Co., *Rollins 3123* (DS); Baldy Peak, Brewster Co., *Warnock 251* (GH); 02 Ranch, about 52 mi. south of Alpine, Brewster Co., *Rollins 3117* (DS); west of Tesnus, Brewster Co., *Rollins 3126* (DS); about 5 mi. south of Shafter, Presidio Co., *Leding s. n.* (NY, UC); about 1.5 mi. so. Shafter,

[1] **Specimens numbered 543a at the New York Botanical Garden and the U. S. National Herbarium are almost certainly part of the type-collection. They are "Boundary Survey" material and differ in no detail from the type.**

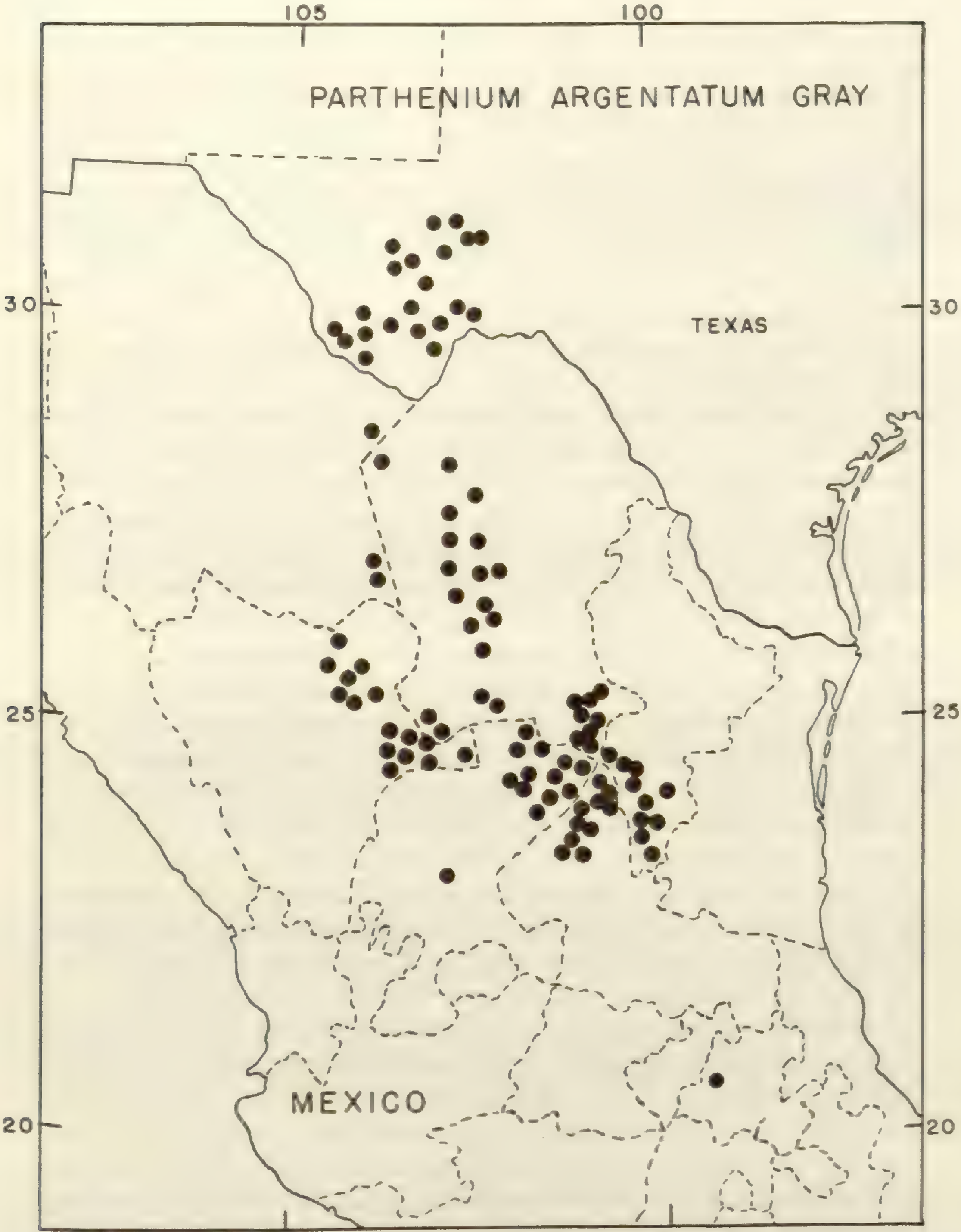

Fig. 14. Geographic distribution of *Parthenium argentatum*.

Presidio Co., *Rollins 3131* (DS); toward head of Fresno Canyon, southeastern Presidio Co., *Rollins 3132* (DS). MEXICO:—**CHIHUAHUA:** Sierra de los Pinos, *LeSueur 1508* (CM, GH). **COAHUILA:** vicinity of Santa Elena Mines, Sierra de las Cruces, *Stewart 619* (GH); San Lazaro, Castaños, *Wynd & Mueller 142* (AA, MO, NY, US); 11 km. northeast of

Jimulco, *Stanford et al. 58* (DS, GH, MO, NY); western base of Picacho del Fuste, northeasterly from Tanque Vaionetta, *Johnston 8431* (GH); Saltillo, *Palmer 9* (GH, NY, US); limestone hills, Carneros Pass, *Pringle 2380* (GH, MO, NY, UC, US); Sierra de Parras, *Purpus 1013* (GH, MO, NY, UC). **DURANGO:** southwest of Mapimi, *Rollins 3096* (DS). **ZACATECAS:** near Conception del Oro, *Palmer 374* (GH, MO, NY, US); Hacienda de Cedros, *Lloyd 255* (GH, type; UC, isotype of *P. Lloydii*); foothills, their ridges and slopes, Cedros, *Lloyd 100* (UC, US); about 30 mi. west of Catorce, *Rollins 3130* (DS). **SAN LUIS POTOSI:** Santo Domingo Road, Charcas, *Lundell 5576* (AA, CAS, CM, US); San Luis Potosí, *Parry & Palmer 435* (GH, US). **HIDALGO:** Ixmiquilpan, *Rose et al. 9032* (GH, US).

The complicated pattern of reproduction (Powers and Rollins, 1945) found in *P. argentatum* is reflected to a slight extent in the specimens found in herbaria, but it is impossible to classify them accurately on this basis. From the trichomes, leaf-shape and form of the inflorescence, it is relatively a simple matter to determine whether or not a given specimen came from a plant which had been diluted with genes of *P. incanum* through hybridization. Polyploidy in both *P. argentatum* and *P. incanum* and hybridization between these species at various levels of chromosome-number, offer possibilities for many types of hybrids (Rollins, 1944, 1945). Hybrids grown from seed collected at widely separated stations in Texas and Mexico formed a series of transitional steps from *P. argentatum* on the one hand to *P. incanum* on the other. However, in the herbaria, no hybrids intermediate between the species have been seen and only about one-fourth of the specimens of *P. argentatum* studied showed evidence of having been diluted by *P. incanum*. Both natural hybrids and artificially produced hybrids between these two species were found to produce large quantities of viable seed, yet no truly intermediate interspecific hybrid populations are known in the wild. Less than one-tenth of one per cent of a population of over 200,000 plants grown from seed of *P. argentatum* collected in the wild, proved to be normal intermediate hybrids (Rollins, 1944). Aberrant hybrids, triploid with respect to their immediate parents, were more abundant. The latter were less vigorous than either parental species and would not be expected to survive under natural conditions of competition, but the normal intermediate hybrids seem not to be similarly handicapped.

P. argentatum and *P. incanum* grow contiguous to each other or even intermixed over wide areas of their ranges. They are

highly compatible species. Why, then, do they not hybridize more freely? Two factors, at least, operate to limit the amount of crossing between them. Perhaps of some importance is the fact that both species reproduce apomictically over much of their natural ranges. But evidence of introgressive hybridization is commonest in areas where both facultative apomixis and polyploidy occur (Rollins, 1949). A sexual phase of *P. argentatum* is known, but it is more restricted distributionally than the facultatively apomictic phase. Initial successful interspecific crossings are apparently infrequent over much of the range of the species but the effects of introgression of one species into the other are widespread. A second factor limiting initial crossing is that of time of flowering. *P. argentatum* largely precedes *P. incanum* in flowering, thus further restricting the chance of interspecific hybridization taking place.

Apomixis is facultative in both *P. argentatum* and *P. incanum*. The number of sexually produced offspring varies from plant to plant in primarily apomictic populations of *P. argentatum*. The variation ranges from one or two per cent to nearly forty per cent. This allows crossing to occur occasionally even between highly apomictic populations of the two species. A high percentage of the hybrids thus produced undoubtedly possesses an unreduced chromosome-complement from the mother plant. Aberrant hybrids of this type have only a limited chance of survival, because of their reduced vigor. The occasional normal intermediate hybrids produced, apparently are not particularly successful in starting independent populations but do function in back-crossing to the parental species. A series of particularly successful types has arisen by the crossing of intermediate interspecific hybrids back to *P. argentatum*. Plants derived from such a cross are always classed as *P. argentatum* by the taxonomist, but a careful study unmistakably uncovers the effects derived from the presence of *P. incanum* genes. Such plant-types bear a common stamp of likeness although they differ from area to area throughout the range of *P. argentatum*. At least in the northern and eastern portion of the range of *P. argentatum* these derived hybrid types are quite stable in their morphology because they reproduce almost exclusively by apomixis. Interestingly enough, the type and isotype specimens of *P. argentatum* are of one of these derived hybrid types.

The work of Nicolaieff (1929) deserves some special discussion. The plants upon which Nicolaieff based his characterizations

were grown under uniform conditions from seed collected in Mexico. Several generations of plants were grown and a number of different types were observed to remain constant from generation to generation. These types differed in growth-form, leaf-shape and -size, pubescence and other characters. Since the differences were shown to be genetically stable, Nicolaieff assumed that the different types represented different systematic entities and named them as varieties. However, he was not aware that apomixis was a prominent method of reproduction in *P. argentatum* and that the varieties he described did not represent freely interbreeding populations. Had he known this, his point of view would probably have been different. Were we to follow Nicolaieff's lead and name as varieties all of the recognizably different true-breeding types of *P. argentatum*, the number of varieties would undoubtedly reach several hundred. We view such a course as unwarranted and not productive of a sensible classification of the plants involved. Rather, I prefer to recognize that facultative apomixis occurs at several different chromosome-levels, and that the other deviations (Powers and Rollins, l. c.) from sexual reproduction prevalent in *P. argentatum* produce many different and genetically stable populations; that gene-interchange may be absent or of very low frequency between these populations and may be very infrequent even within the respective populations themselves; and that a complex hybridizing pattern between *P. argentatum* and *P. incanum* complicates the picture very considerably. As a result, the development of a formal system of classification of the different subspecific populations of *P. argentatum* which has any real meaning, is a practical impossibility.

It is possible to identify tentatively various of the varieties described by Nicolaieff with plants of known interspecific hybrid origin. For example, var. *marioloides* is almost certainly a hybrid of *P. argentatum* and *P. incanum*. Furthermore, it appears to be about intermediate between these species in its characters. Vars. *latifolium* and *dissectum* are probably of hybrid origin, but are much nearer typical *P. argentatum* than *P. incanum*. From the illustrations of the other varieties described, vars. *deltoideum* and *brevifolium* could either be typical *P. argentatum* or diluted by some introgressed genes from *P. incanum*. Vars. *angustifolium*, *gracile*, and *longifolium*, appear to be variants of typical *P. argentatum*.

Section II. Argyrochaeta (Cav.) DC.

Parthenium, sect. III. *Argyrochaeta* DC. Prod. V: 532. 1836.
Argyrochaeta, Cav. Ic. IV: 54, t. 378. 1797.

Plants herbaceous; leaves deeply lobed to bipinnate; heads hemispherical above; pollen white; pappus of 2 lateral erect to divergent scales. Type-species, *P. hysterophorus* L.

8. **Parthenium confertum** Gray

Biennial or perennial; herbaceous; stems one or few from the base, branched above, longitudinally striate, 2–7 dm. high, densely hirsute with long simple trichomes; lower leaves pinnate to lyrate, petiolate, densely hirsute, trichomes of the veins similar to those of the stem; middle and upper leaves sessile, usually crowded, pinnate to bipinnate, oblong in outline, lobes obtuse, often crenate; heads usually crowded, subcorymbose, 3–6 mm. broad; outer phyllaries broadly oblanceolate to obovate, densely pubescent; inner phyllaries obovate to orbicular with a broad hyaline margin, erose; corolla of ray-florets white, limb very abbreviated to 2.5 mm. long, shallowly emarginate; stigma-lobes equal; achenes broadly oblanceolate to obovate, black, glabrous to sparsely papillose above, 2–3 mm. long, 1.5–2 mm. wide; pappus-scales 2, broadly oblong to ovate or triangular, petaloid, often erose at apex, equaling or slightly exceeding the corolla-tube; stamens exserted during anthesis, pollen white.

Key to the Varieties

A. Ray-florets ligulate; ligule 1–2.5 mm. long, spreading; inner phyllaries rounded below and barely exceeding the achene-complex in width; outer phyllaries with a cusp-like apex, acuminate, equaling to slightly exceeding the inner phyllaries.
  B. Heads compactly arranged; stems branched near summit; leaves crowded; pubescence of stems, petioles and veins of long white trichomes and differing markedly from that of the leaf surfaces ..... 8a. var. *typicum*.
  B. Heads loosely arranged; stems branched from middle or below; leaves not densely crowded; pubescence of stems, petioles and veins similar to or slightly different from that of the leaf surfaces ..... 8b. var. *divaricatum*.

A. Ray-florets eligulate or with a ligule less than 1 mm. long; ligule usually ascending if present; inner phyllaries usually truncate below and markedly exceeding the achene-complex in width; outer phyllaries obtuse, usually one-half to two-thirds the length of the inner phyllaries, rarely equaling them, apex rarely cusp-like.
  C. Heads less than 3 mm. broad, crowded; achenes ca. 1.5 mm. long ..... 8c. var. *microcephalum*.
  C. Heads 4–7 mm. broad, loosely arranged to crowded; achenes 2–3 mm. long ..... 8d. var. *lyratum*.

8a. **Parthenium confertum** Gray, var. **typicum**

P. confertum Gray in Proc. Amer. Acad. XVII. 216. 1882.

Apparently only in the state of **COAHUILA,** Mexico. Specimens examined: Parras, Oct., 1880, *Edward Palmer 648* (GH, type; US, isotype); plain northwest of Parras, *Gregg 25* (GH); plain northwest of San Lorenzo, *Gregg 644* (MO); near Puerto Santa Ana, Muzquiz, *Wynd & Mueller 280* (GH, MO, NY); at the foot of the eastern slope of the Sierra de Puerta Santa Ana, *Wynd & Mueller 252* (GH, MO, US).

8b. **Parthenium confertum** Gray, var. **divaricatum** Rollins, var. nov.

Divaricately branching from a point near the middle of the plant upward; branches at about a 45° angle; upper leaves broadly oblong, sessile, lobed, uniformly pubescent; heads numerous, loosely arranged in diffuse paniculate corymbs; outer phyllaries acuminate, with a cusp-like apex, equaling or exceeding the inner phyllaries; ligules well developed, 1.5–2.5 mm. long.

Herba biennis vel perennis; caulibus divaricatis; ligulis 1.5–2.5 mm. longis.

Texas and Coahuila. **TEXAS:** Low slopes, Guadalupe Mts., *M. S. Young s. n.* (MO); valley of Limpia Creek near Ft. Davis, Jeff Davis Co., *Palmer 32075* (MO); south side of Green Valley, Glass Mts., Brewster Co., *Warnock 595* (GH). **COAHUILA:** Del Carmen Mts., *Marsh 861* (CM, GH); western slopes of Sierra del Carmen, 10 km. northeast of Hacienda de la Encantada, *Stewart 1555* (GH); fls. white, common in meadows, Mesa Grande, high mesa 40 km. northwest of Hacienda de la Encantada, Northern Coahuila, Sept. 14, 1941, *Robert M. Stewart 1662* (GH, type); Cañon de San Enrique, eastern side of Sierra de la Encantada, 5 km. west of Rancho Buena Vista, *Stewart 1415* (GH); 1 km. northwest of Puerto del Aire, the pass at the southern end of Sierra de la Encantada, *Stewart 1311* (GH).

8c. **Parthenium confertum** Gray, var. **microcephalum** Rollins, var. nov.

Plants branching near the top, branches erect to divaricately ascending; stems densely leafy, densely pubescent with long white trichomes; leaves deeply lobed, pinnate to bipinnate, trichomes of petioles and veins much longer than those of the blade-surface; heads congested, small, less than 3 mm. broad; achenes 1.5–2 mm. long.

Herba perennis; caulibus pilosis; capitulis 2–2.5 mm. latis.

Texas and Chihuahua. **TEXAS:** 17 miles southwest of Toyahvale, Jeff Davis Co., Oct. 30, 1935, *V. L. Cory 17587* (GH, type); 10 miles south of Marathon, Brewster Co., *Norvell* R 19 (GH); Langtry, Valverde Co., *Orcutt 6200* (MO). **CHIHUAHUA:** Sierra de los Pinos, *LeSueur 1523* (CM, GH).

8d. **Parthenium confertum** Gray, var. **lyratum** (Gray) comb. nov.

P. hysterophorus L., var. *lyratum* Gray in Proc. Amer. Acad. XVII: 216. 1882.

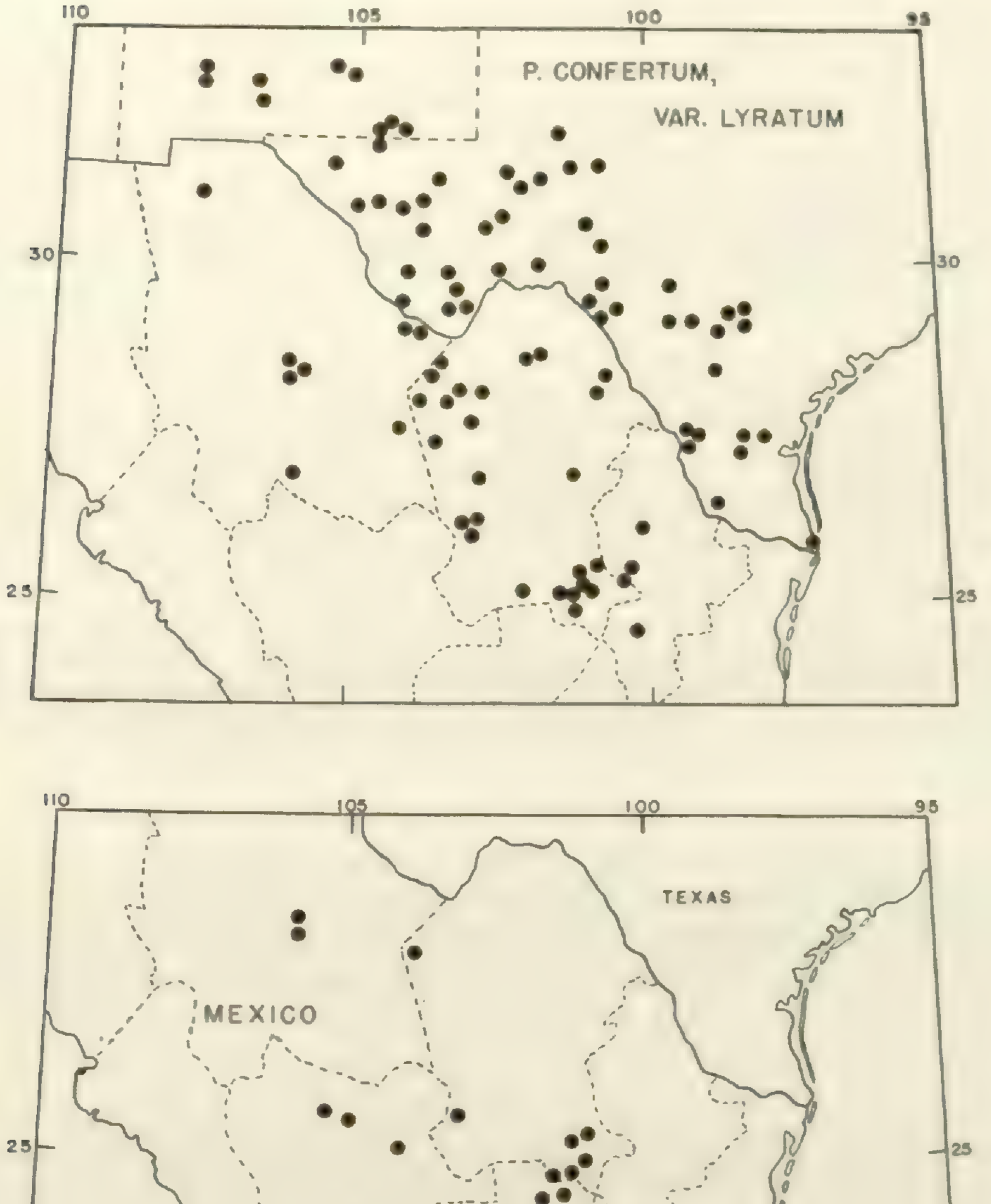

Fig. 15 and 16. Fig. 15. Geographic distribution of *Parthenium confertum*, var. *lyratum*. Fig. 16. Geographic distribution of *Parthenium bipinnatifidum*.

P. lyratum Gray, Syn. Fl. N. Am. I, Pt. 2, 244. 1884.

Western Texas, New Mexico to San Luis Potosí and Zacatecas, Mexico. Fig. 15. Representative specimens:—**TEXAS:** "On the Rio Grande," Oct. 1849, *C. Wright 316* (GH, type; NY, US, isotypes); 20 mi. south of San Antonio, Bexar Co., *Schulz 460* (US); 3 miles west of Castroville, Medina Co., *Shinners 7283* (GH); Dilley, Frio Co., *Tharp 49* (UC); Alice, Jim Wells Co., *Palmer 11254* (MO, UC, US); San Diego, Duval Co., *Croft 4055* (NY, US); between Sullivan City and Rio Grande, Starr Co., *Runyon 1732* (US); Point Isabel, Cameron Co., *McKelvey 1757* (GH); San Angelo, Tom Green Co., *Bray 354* (US); Sandy plains, Kimble Co., *Reverchon 1315* (NY, UC, MO, US); Aldwell Bros. Ranch, Sutton Co., *Cory 4902* (GH); Barksdale, Edwards Co., *Palmer 10987* (DS, MO, US); Sabinal, Uvalde Co., *Palmer 10123* (DS, MO, US); Spofford Junction, Kinney Co., *Orcutt 5047* (DS); sands, Laredo, Webb Co., *Reverchon 3979* (GH, MO, US); Big Spring, Howard Co., *Innes and Moon 1073* (GH); 1 mi. west of Rankin, Upton Co., *Cutler 3285* (US); 1.5 miles east of Stiles, Reagan Co., *Cory 770* (GH); Del Rio, Valverde Co., *Jones 26391* (DS, US); 4 mi. south of Crane, Crane Co., *Tharp s. n.* (GH); Ft. Stockton, Pecos Co., *Wooton s. n.* (US); 21 mi. northeast of Dryden, Terrell Co., *Cory 3558* (GH); vicinity of Pecos, Reeves Co., *Gillespie 5272* (DS, GH, UC, US); Ft. Davis, Jeff Davis Co., *Ferris and Duncan 2650* (CAS, DS, MO); Emory Peak, Chisos Mts., Brewster Co., *Mueller 8224* (CM, GH, MO, UC, US); Marfa, Presidio Co., *Plank s. n.* (NY); Kent, Culberson Co., *Tracy and Earle 324a* (GH, NY, MO, US); 3 mi. west of Salt Flats, Hudspeth Co., *Waterfall 3836* (GH). **NEW MEXICO:** 15 mi. south of Carlsbad, Eddy Co., *Waterfall 3730* (GH); Black River, Eddy Co., *Standley 40473* (US); 30 mi. west of Roswell, Lincoln Co., *Wooton s. n.* (US); Lincoln, Lincoln Co., *F. S. and Esther Earle s. n.* (NY); limestone hills, Kingston, Sierra Co., *Metcalfe 1497* (CAS, CM, GH, MO, UC, US); Black Range Ranger Sta., Gila Forest (Kingston), Sierra Co., *Eggleston 16332* (GH); Soledad Canyon, Dona Ana Co., *Wooton s. n.* (US); Organ Mts., Dona Ana Co., *Wooton & Standley s. n.* (US). MEXICO:—**CHIHUAHUA:** San Pedro, Sierra Madre Mts., *M. E. Jones s. n.* (DS, MO, US); 5 miles southeast of San Carlos, *Johnston & Muller 88* (GH); Santa Eulalia Mts., *Pringle 631* (GH, Ph, US); Santa Eulalia plains, *Wilkinson s. n.* (DS, GH, US); northwestern end of Sierra del Diablo, *Stewart 990* (GH); Parral, *Goldman 104* (GH, US). **COAHUILA:** valley extending northeast from Tanque Armendaiz to south end of Sierra del Pino, *Johnston & Muller 368* (GH); near Diaz (now Piedras Negras) *Pringle 9017* (GH, MO, US); El Barrendo, near Muzquiz, *White 1833* (GH); Sabinas, *Nelson 6790* (US); Sierra de la Madera, vicinity of "La Cueva," Corte Blanco fork of Charretera Canyon, *Johnston 8957* (GH); Cerro de Cypriano, *Purpus 4477* (GH, MO, UC, US); Saltillo, *Palmer 10* (GH, MO, UC, US); Sierra de Parras, *Purpus 4652* (MO, UC); near Parras, *Palmer 647* (GH, US). **NUEVO LEON:** about 15 miles southwest of Galeana, *C. H. and M. T. Mueller 1044* (CM, GH); mountains near

Monterrey, *C. H. and M. T. Mueller 234* (CM, GH). **SAN LUIS POTOSI:** Charcas, *Lundell 5206* (DS, US). **ZACATECAS:** Hacienda de Cedros, *Lloyd 155* (US).

Gray did not designate a type for either *P. confertum* or the var. *lyratum*. For var. *typicum* I have selected the cited Palmer specimens as the type-series because they are more ample than the material of Gregg. For var. *lyratum*, Wright no. 316 was more or less arbitrarily selected as the type, but it more truly represents the entity than does Palmer 647, which is nearer in its characters to var. *typicum*.

The total material of *P. confertum* is by no means uniform throughout its range. There is considerable variation as to the amount of lobing of the lower leaves, particularly in var. *lyratum*. In the eastern part of the latter's range, the lower leaves are pretty generally lyrate, but westward, particularly in New Mexico and Mexico, they are more highly dissected. However, it is not always possible to determine this point on herbarium material. Cultures of var. *lyratum* show that the young plants may have lyrate lower leaves, but as these same plants increase in age, the lower leaves are shed and only pinnate leaves remain.

Although typical *P. confertum* as well as var. *lyratum* are biennial or perennial, they are very closely related to *P. bipinnatifidum* and *P. hysterophorus*. In fact, some of the specimens referred to *P. confertum*, var. *lyratum*, except for the larger heads, more copious pubescence, and more durable root, might easily be placed in *P. bipinnatifidum*. As I see the relationship in this group, typical *P. confertum* and typical *P. hysterophorus* stand farthest apart. *P. confertum* var. *lyratum* and *P. bipinnatifidum* approach each other in their characters and almost bring all three species together. It is quite likely that hybridization between these species occurs and probably accounts for the intermediate material that practically bridges the gap between them. However, it should be stressed that the basic chromosome-number in *P. bipinnatifidum* is very different from that of *P. confertum* and *P. hysterophorus*. More information is needed to show what has actually taken place to produce these intermediate populations. There is some possibility that var. *microcephalum* is of hybrid origin and represents a population of the above described type.

Gray first described *lyratum* as a variety of *P. hysterophorus*. Later, with more material for study, he elevated the variety to specific rank. However, his remark (1884) that *P. lyratum* was

"equally allied to the preceding species (*P. hysterophorus*) and to the Mexican *P. confertum*," shows that he understood the general relationships involved. If only plants of Texas were considered, there would be no difficulty in maintaining var. *lyratum* at the specific level. However, westward into New Mexico and Mexico, the Texas form becomes so thoroughly mixed with plants resembling typical *P. confertum*, that it is difficult to determine where a given specimen should be placed. From my study, I should suggest that to maintain *P. confertum* and *P. lyratum* as species would be fostering misconceptions as to the relationships in the group. It would be better to list *P. lyratum* as a straight synonym of *P. confertum*. However, I have chosen to indicate the trend away from typical *P. confertum*, particularly by plants growing in western Texas, by placing *P. lyratum* in a varietal category under *P. confertum*.

Chromosome-counts have been previously reported on several plants of a Texas collection of *P. confertum* var. *lyratum* (as *P. lyratum;* Rollins, 1946). All but one of the nine plants examined possessed $2n = 68$. This one plant had approximately $2n = 102$ chromosomes. The latter showed the familiar characteristics of a high-chromosome plant. The leaves were thicker, the heads and pollen were larger, and the plants were more robust than the 68-chromosome plants. Among herbarium specimens of var. *lyratum*, I have noted two plants from widely separated stations which, on the basis of the size of the flower parts, appear to be high-chromosome types.

In *P. confertum*, the ligule is best developed in var. *divaricatum* which resembles var. *typicum* in this respect. However, the numerous heads are not congested nor are the stem and petiole trichomes nearly so long and whitish as in the typical variety. The Mexican material of var. *divaricatum* seems quite distinctive as does that cited from Texas, but certain specimens placed in var. *lyratum*, such as Palmer No. 10987 from Barksdale, Edwards County, Texas, are somewhat borderline between these varieties. Such difficulties strongly suggest a complex relationship between semi-isolated populations of *P. confertum*. Certainly the numerous variants of this species are difficult to handle taxonomically.

More recent studies on plants from several locations (Table I) confirm the somatic number of 68 as a common one for var. *lyratum*. But it is highly significant that one collection appears to be diploid, with a somatic number of 34. Comparisons of the

morphology of this collection with other herbarium material strongly suggest that the bulk of var. *lyratum* is tetraploid, with $2n = 68$.

In comparing the whole of *P. confertum* and *P. hysterophorus*, one is led to wonder how much of the distinctiveness of certain phases of *P. confertum* is attributable to the fact that they have double the chromosome-number of *P. hysterophorus*. The larger heads and biennial or perennial habit of much of the material of var. *lyratum* suggests that polyploidy has played a role in the origin of portions of this species. It is not improbable that the 34-chromosome type in var. *lyratum* may have crossed with *P. hysterophorus* to produce amphiploid types now treated as var. *lyratum*. A thorough study of this aspect of the relationships of these two species would be of considerable interest.

9. **Parthenium densipilum** Blake

Parthenium densipilum Blake, Contrib. U. S. Nat. Herb. 22: 607. 1924. pl. 58.

Stout annual or possibly more enduring; stems several to numerous from the base, simple below, sparingly branched near summit, lightly striate, very densely white-hirsute with spreading simple trichomes; about 3.5 dm. high, leaves similar throughout, obovate to oval in outline, sessile or narrowed into a petioliform base, lyrately lobed or toothed, the terminal lobe large, obtuse, coarsely crenate-dentate, densely hirsute with whitish trichomes, 3–10 cm. long, 1.5–6 cm. wide; heads about 4 mm. wide, outer phyllaries greenish toward apex, hirsute, obovate-oval, inner phyllaries scarious, suborbicular, erose above, pubescent; rays white, erect, sparsely pubescent on outer surface, about 1 mm. high; stigma of ray-florets equaling or slightly exceeding corolla, stigma-lobes equal; pappus of two triangular-oblong paleae, erose and acute above, slightly less than 1 mm. long, pubescent; achenes oblanceolate, obcompressed, black, nearly glabrous, 2–2.5 mm. long.

Known only from the type specimen collected at Buena Vista, Tamaulipas, Mexico, June 16, 1919, *E. O. Wooton s. n.* (US).

This species appears to be most closely related to *P. confertum*, var. *lyratum* on the basis of pubescence, shape of paleae, shape of corolla and type of leaf. However, a single specimen does not give any basis for attempting to do more than conjecture upon relationship. Also there is no basis for comments concerning the variation of the species. In my judgment, a distinct species is represented by this one collection, but the nature of it will remain obscure until further material is available for study.

10. **Parthenium hysterophorus** L.

Parthenium hysterophorus L., Sp. Pl. II: 988. 1753.
P. pinnatifidum Stokes, Bot. Mat. Med. IV. 278. 1812.
P. lobatum Buckley, Proc. Acad. Sc. Phila. 1861: 457. 1862.

Herbaceous annual; stems hirsute, single from the base, paniculately branched above, longitudinally striate, 3–10 dm. high; lower leaves forming a basal rosette, pinnate to bipinnate, hirsute, petiolate; upper leaves entire to slightly lobed, sessile or petiolate, hirsute; heads numerous, borne in open panicles, 3–4 mm. broad, densely pubescent; outer phyllaries oblong to slightly broader, pubescent, ciliate to only slightly so, inner phyllaries broadly obovate, scarious-margined, pubescent, ciliate to only slightly so; corolla white, erect, emarginate to nearly entire; pappus-scales two, petaloid, closely adjoining corolla on either side, ovate to oblong, entire to faintly notched, equalling or exceeding the corolla-tube; stigma-lobes equal; stamens exserted during anthesis; pollen white; achenes black, broadly oblanceolate to narrowly obovate, glabrous below, sparsely papillose with achenial trichomes toward apex, 2–2.5 (3.5) mm. long, 1.1–1.5 (2.0) mm. wide. $2n = 34$.

Apparently native to the West Indies and adjacent North and South America, and possibly in south central South America. Adventive in widely scattered places in subtropical areas of the world. Representative specimens:—North America; **MASSACHUSETTS:** near railroad track, Worcester, *N. P. Woodward, s. n.* (GH); wool waste, Auburn, Worcester Co., *B. N. Gates* (NEBC); dump, Lowell, Middlesex Co., *C. W. Swan s. n.* (NEBC). **NEW JERSEY:** on ballast, Kaigns Point, *Isaac Burk, s. n.* (CM). **PENNSYLVANIA:** along Delaware River, Richmond, Philadelphia Co., *T. O'Neill, s. n.* (GH). **MICHIGAN:** New Michigan Union Bldg., Ann Arbor, *Ehlers 652* (GH). **OHIO:** Columbus, *E. V. Wilcox, s. n.* (CM). **ILLINOIS:** East St. Louis, *G. W. Letterman, s. n.* (Ph, UC, US). **MISSOURI:** waste ground, Sheffield, *Bush 9476* (CM, MO); Kansas City, *Bush 11630* (MO). **ARKANSAS:** Beaver, Carroll Co., *Palmer 29348* (GH, MO); Eudora, Chicot Co., *Demaree 14081* (MO, US). **KANSAS:** Salina, Saline Co., *Hancin 1990* (MO). **OKLAHOMA:** Tulsa, *A. H. Hawk, s. n.* (MO); Tecumseh, *E. D. Barkley 393* (MO). **ALABAMA:** vacant lot, Birmingham, *Harper 3434* (GH); Mobile, *Arushel s. n.* (MO). **FLORIDA:** outskirts of Mariana, Jackson Co., *Wiegand & Manning 3338* (GH); Jacksonville, *C. S. Williamson, s. n.* (UC); St. Augustine, *B. F. Leeds, s. n.* (CM); waste places, Apalachicola, Biltmore Herb. 4300b (GH); waste places, Key West, *Curtiss 5649* (GH, MO, UC). **MISSISSIPPI:** Bay of St. Louis, *W. Rhoades, s. n.* (GH); Biloxi, *Tracy 6454* (GH). **LOUISIANA:** school ground, Lockport, *Morillon 2* (GH); New Orleans, *Drummond 165* (GH); waste places, Pointe a la Hache, *A. B. Langlois, s. n.* (DS). **TEXAS:** Dallas, *Reverchon 481* (CM); Camp Barkley, Taylor Co., *Tolstead 7673* (UC); near Braken, Bexar Co., *Groth 42* (DS, GH); New Braunfels, *Lindheimer 951* (GH, MO, UC); Corpus

Christi, Nueces Co., *Heller 1418* (GH, MO, UC); Ranch Exp. Sta., Edwards Co., *Cory 3554* (GH); ½ mi. north of Edinburg, Hidalgo Co., *Ferris & Duncan 3062* in part (CAS, DS, MO); Rio Hondo, Cameron Co., *Chandler 7052* (GH, MO, UC); Western Texas, June, *S. B. Buckley s. n.* (Ph., type of *P. lobatum* Buckley). MEXICO; **NUEVO LEON:** 28 mi. so. of Nuevo Laredo, *T. C. & E. M. Frye 2351* (DS, GH, MO, UC); Villa de Santiago, *Leavenworth 85* (CM, GH, MO, UC); above La Mina, near Monterrey, *C. H. & M. T. Mueller 235* (CM, GH). **COAHUILA:** Monclova, *White 1739* (DS); *Marsh 2247 & 2240* (GH). **TAMAULIPAS:** 10 km. northwest of El Progresso, *Stanford, Retherford & Northcraft 1074* (DS, GH, MO); Soto la Marina, *Nelson 66038* (GH); vicinity of Tampico, *Palmer 9* (GH, MO). **SAN LUIS POTOSI:** El Pujal, *Chase 7469* (CM, GH, MO); Tamazunchale, *Edwards 676* (CM, DS, MO). **HIDALGO:** Jacala, *Edwards 891* (CM). **VERA CRUZ:** Palmar, *MacDaniels 433* (CM); Córdoba, *Greenman 300* (CM, GH). **MEXICO:** near San Pablo, *Happ 298* (MO). **PUEBLA:** Orizaba, *Seaton 14* (GH); Région D'Orizaba, *Bourgeau 1558* (GH, US). **SINALOA:** Culiacán, *Brandegee s. n.* (UC); Mazatlán, *Ferris 5014* (DS); Mazatlán, *Wright 1209* (DS, MO, UC); vicinity of Labradas, *Ferris & Mexia 5294* (DS); Rosario, *Ortega 6412* (DS, GH). **NAYARIT:** Tres Marias Islands, *Ferris 5589* (DS); Tepic, *Jones 23406* (DS, MO). **JALISCO:** between Los Palmas and Ixtapa, *Nelson 4134* (GH). **COLIMA:** Manzanillo, *Palmer 921* (GH, UC). **MICHOACAN:** Apatzingán, *Hinton 12031* (GH); Coalcomán, *Hinton 12825* (GH, MO). **OAXACA:** valley of Etla, *Alverez 745* (GH); Valley of Oaxaca, *Conzatti & Gonzales 89* (GH). **CAMPECHE:** Tuxpena, *Lundell 1008* (DS, UC). **YUCATAN:** Izamal, *Gaumer 558* (CAS, CM, DS, GH, MO, UC); San Anselmo, *Gaumer 1848* (CM, GH, MO); Chichankanab, *Gaumer 1555* (CM); Island of Cozumel, *Millspaugh 1572* (CM); Chichen Itzá, *Steere 1020* (MO). **BRITISH HONDURAS:** Honey Camp, Orange Walk, *Lundell 46* (CM); Corozal, *Lundell 4756* (CM, MO). **GUATEMALA:** Libertad, *Lundell 3730* (CM). WEST INDIES; **BERMUDA:** near Flatts, *Collins 39* (GH). between Hamilton and Spanish Point, *Robinson 136* (GH); Hamilton, *Broun & Britton 149* (GH); Paget, *Harshberger s. n.* (GH, MO). **BAHAMA ISLANDS:** without locality *Bryant s. n.* (GH). Fox Hill Village, Nassau, *Wight 23* (GH). **CUBA:** Cieneguita, Cienfuegos, *Combs 250* (GH, MO); Nueva Gerona, Isle of Pines, *Curtiss 509* (GH, MO). **JAMAICA:** Queen Anns Bay, *Churchill s. n.* (GH); Balaclava, *Orcutt 2282* (UC); vicinity of Montego Bay, *Maxon & Killip 1602* (GH, MO). **HAITI:** vicinity of Port au Prince, *Leonard 2788* (GH); Miragoane and vicinity, *Eyerdam 416* (GH); vicinity of St. Michel de L'Atalaye, *Leonard 7315* (UC); Moncion, Santo Domingo, *Valeur 141* (CAS, DS, MO, UC); Santo Domingo, *C. A. Meyer* in 1842 (GH). **PORTO RICO:** Mayaguez, *Holm 262* (GH, MO). **LESSER ANTILLES:** St. Thomas, *Pease 22917* (UC); Virgin Islands, *Fishlock 25* (GH); St. Bartholomew, *Forsstrom s. n.* (CM); St. Croix, *Ricksecker 6* (DS, GH, MO, UC); Martinique, *Duss 964* (US); Dominica, *Hodge 3189* (GH); St. Vincents, *H. H. & G. W. Smith*

152 (GH); Barbados, Aug. 27, 1905, no. 121 of Bot. Gard. Herb. (GH); Grenada, St. George's, *Broadway s. n.* (GH); Tobago, Scarborough, *Broadway 4262* (GH, MO); Trinidad, *Broadway 6297* (MO, UC). **DUTCH WEST INDIES:** Curaçao, *Curran & Haman 68* (GH, UC). SOUTH AMERICA; **VENEZUELA:** Island of Margarita, *Miller & Johnston 233* (GH, MO); Miranda, *Williams 10891* (CM, UC); Caracas, *Moore 10* (GH); Barquisimeto, *Saer 586* (CM). **BRITISH GUIANA:** Georgetown, *Potter 5268* (GH). **BOLIVIA:** Cochabamba, *Parodi 10223* (GH); same locality, *Steinbach 3988* (GH); Santa Cruz, *Peredo s. n.* (ILT); Buenavista, Santa Cruz, *Steinbach 6344* (GH). **PARAGUAY:** zwischen Rio Apa und Rio Aquidaban, *Fiebrig 4983* (GH). **URUGUAY:** Dept. Rio Negro, *Herter 1638* (GH). **ARGENTINA:** Perico, Jujuy, *West 8373* (GH, MO, UC); Lagunas Yala, *O'Donell 4877* (ILT); Ledesma, Jujuy, *Eyerdam & Beetle 22621* (GH, UC); Chicoana, Salta, *G. Romero s. n.* (ILT); Candelaria, Salta, *Venturi 3830* (GH); Cochuna, Tucumán, *O'Donell 26* (GH); Sierra del Cahone, *Venturi 4417* (GH, polyploid? or another species?); La Ramada, Tucumán, *Ousset 98* (GH); Santa Rosa, Catamarca, *Brizuela 143* (GH); Andalgalá, Catamarca, *Jörgensen 1086* (GH, UC); Rio Hondo, Santiago del Estero, *Ousset 47* (GH); Sumanpa, Santiago del Estero, *Bolegno 28* (ILT); Cerro de la Gloria, Mendoza, *Mexia 04371* (GH, MO, UC); Villaguay, Entre Rios, *Meyer 11,149* (GH); Ascochinga, Córdoba, *Hunziker 1491* (ILT, MO); Cerro Las Rosas, Córdoba, *Hunziker 7365* (GH); Sierra de Tandil, Partido Tandil, Buenos Aires, *Sotelo 34* (ILT). **SOCIETY ISLANDS:** Papeete, Tahiti, *Leland, Chase & Tilden 12* (CM, GH, UC, US). **NEW CALEDONIA:** Nouméa, *Franc 628* (GH, UC, US). **INDO-CHINA:** Hanoi, *Pételot 267* (UC, US); Haiphong, *J. & M. S. Clemens 4267* (UC); Hué and vicinity, *Squires 407* (CAS, UC, US).

It is impossible to determine accurately the natural range of *P. hysterophorus* because of the fact that it is an aggressive weed. It is frequently found in waste places in or near cities and is particularly common about sugar cane fields in many areas. The best surmise seems to be that the species is native to the area around the Gulf of Mexico, including the West Indies. Outside of this general region it appears to be adventive, although it may be native in central South America.

Biologically, *P. hysterophorus* is composed of a number of diverse forms, many of which are quite widespread. Some specimens from Mexico approach *P. bipinnatifidum* rather closely, suggesting that hybridization very likely occurs between these two species. The species is most complex and puzzling in central South America. In this area it tends to be longer-lived than elsewhere in its range and there are many variants from different populations. On the basis of the variation in *P. hystero-*

phorus outside of South America, it is difficult to account for many of the characteristics that are found in specimens from that area. Some plants appear to have characters derived from both *P. confertum* and *P. bipinnatifidum* although neither of these species is known south of Mexico. Remembering that *P. hysterophorus* is a weed in fields and waste places in an area where the seasons are reversed from those of its probable place of origin, it seems possible that particularly favorable conditions for rapid biotype-formation are present. Perhaps the extreme variation in size of plants, leaf-form and -cutting, density of indument, corolla-form, pappus-form and -position, distribution of leaf-glands, and similar characteristics may be accounted for in this way. However, the group needs intensive study by botanists who have the opportunity for field study.

Plants grown from seeds obtained near Córdoba by Dr. Armando Hunziker proved to have the usual $2n = 34$ chromosomes. Also, these plants were surprisingly similar under greenhouse conditions to others grown from seed obtained in Texas. But the specimens from around Córdoba do not deviate from typical *P. hysterophorus* as do those from Mendoza or particularly those from Sierra de Tandil in the Province of Buenos Aires. It is highly probable that polyploidy has played a role in producing the diversity of forms found in central South America. The evidence for this comes from a single specimen in the Gray Herbarium, *S. Venturi No. 4417* from the province of Tucumán, Argentina. In this specimen, the stems and leaves are thicker, the heads are broader and all the floral parts are considerably larger than in typical *P. hysterophorus*. Measurements of ten mature achenes from this specimen showed a minimum–maximum length of 3–3.5 mm. At the widest point they were 1.5–2 mm. For comparison, ten mature achenes from specimens of more nearly typical *P. hysterophorus* from the Province of Tucumán, though not from the same location, showed the following dimensions: length 1.5–2 mm.; width 1–1.5 mm. Similarly the inner phyllaries of the Venturi specimen were 3.5–4 mm. long and 3–3.5 mm. wide, whereas inner phyllaries from the other material were 1.5–2 mm. long and 1.25–1.75 mm. wide. Differences in size of floral parts were of the same magnitude throughout. Not only are there quantitative differences as indicated, but qualitative differences of a minor nature are also present. For example, in the Venturi specimen, the achenial trichomes are

distributed over the entire achene while in the other material these trichomes are restricted to an area near the summit of the achene and on the ventral rib. Also, the inner phyllaries differ in shape, those of the Venturi specimen being nearly orbicular while those of the other specimens are broadly obovate. With these considerations, the question arises as to whether the Venturi specimen represents a polyploid population, which seems to me most likely, or whether it represents a distinct natural taxon of the species- or subspecies-level. These questions can only be settled by those with access to living material and preferably to growing populations in Argentina. However, it does seem clear that if the Venturi specimen represents a polyploid population, these polyploids have not arisen by direct autoploidy from the other Tucumán material considered in this study. The definite possibility that several subspecies are present in the Argentine flora should not be overlooked in future intensive studies.

Plants of *P. hysterophorus* have been grown from several lots of seed from Texas, Mexico and South America. The young rosette of leaves is always highly dissected and tends to be flat on the ground-surface. Mature seeds may be produced in less than six months, beginning with young seedlings. Normally, the plants die after producing a crop of seeds, but if the upper portion is kept cut back, they will live for an extended period. Attempts were made to cross *P. hysterophorus* with *P. tomentosum*, vars. *typicum* and *stramonium*, *P. argentatum* and *P. incanum* (Rollins, 1946). Several hybrid plants from the cross *P. argentatum* ♀ × *P. hysterophorus* ♂ were obtained. Two hybrid plants from the cross *P. incanum* ♀ × *P. hysterophorus* ♂ grew to maturity. The other attempts were unsuccessful. All the hybrids had comparatively high chromosome-numbers and were found to possess an unreduced chromosome-complement contributed by the female parent in each case. Even so, it was something of a novelty to obtain hybrids from crosses having a woody shrub as one parent and an herbaceous annual as the other.

The chromosome-number of *P. hysterophorus* has been determined upon eight separate collections from wild sources and found to be $2n = 34$ in each case. One collection showed $2n = 35$ from several counts, but I was not able to discover how the extra chromosome came to be present. It seems probable that our slides merely chanced to show countable figures of this number and that no importance should be attached to it. How-

ever, the fact that this odd number was observed shows that there must have been lagging in one chromosome-pair.

11. **Parthenium bipinnatifidum** (Ortega) comb. nov.

Villanova bipinnatifida Ortega, Nov. Rar. Pl. Hort. Matr., Dec. IV: 48, t. 6. 1797.

Argyrochaeta bipinnatifida Cavanilles, Icon. IV: 54, t. 378. 1797.

Herbaceous annual, stems single, weak and widely branching from near the base upward, quite often decumbent, hirsute with simple trichomes, 1–5 dm. long; leaves bipinnate, petiolate, lobes oblong, obtuse and widely divergent, hirsute, trichomes of the veins much larger than those of the blade proper; lower leaves spaced by evident internodes, not forming a basal rosette; upper leaves well-developed, often overtopping the inflorescence; heads in somewhat condensed panicles, densely pubescent, 4–5 mm. broad; outer phyllaries broadly oblong, pubescent, usually ciliate; inner phyllaries broadly obovate, pubescent; corolla white, closely surrounding the style, ligule emarginate, less than 1 mm. long; pappus variable in shape, ovate, oblong, or obovate, equaling or exceeding the corolla; stigma-lobes equal; stamens exserted during anthesis; pollen white; achenes black, broadly oblanceolate to narrowly obovate, glabrous below, sparsely papillose above, 2–2.5 mm. long, 1–1.3 mm. wide. 2n = 24.

Native to the highlands of central Mexico. Fig. 16. Representative specimens:—Mexico: Without locality, *Sessé and Mociño 4636* (CM); **CHIHUAHUA:** Santa Eulalia, *Shreve 9100* (GH); Cerro de Vergara, Santa Eulalia, *Lopez 44* (GH). **COAHUILA:** northeast of San Vicente, *Johnston & Muller 1062* (GH); Saltillo, *Palmer 333* (GH, MO, US); Saltillo, *Arsène 6363* (GH, MO, US); between Palos Blancos and San Pedro, *Johnston 9280* (GH); Mahorachic, *Knobloch 5260* (CM); 15 km. west of Conception del Oro, Coahuila-Zacatecas border, *Stanford et al. 503* (DS, GH, MO). **NUEVO LEON:** Hacienda Pablillo, Galeana, *Mary Taylor 29* (CM, DS, MO). **ZACATECAS:** Cedros, *Lloyd 85* (MO, UC). **TAMAULIPAS:** near Miquihuana, *Stanford et al. 799* (MO). **DURANGO:** Inde, *Peko 5302* (CM); Durango and vicinity, *Palmer 12* (CAS, GH, MO, UC); Rio Nazas, between Mapimi and Durango, *Norvell h. r. 30* (GH); 60 km. west of Mapimi, *Norvell, s. h. r. 29* (GH). **SAN LUIS POTOSI:** region of San Luis Potosí, *Parry & Palmer 436* (MO, US); cultivated from seed collected near Zapitillo by O. W. Norvell, *Rollins 481015* (GH). **JALISCO:** Ocotlari, *Furness s. n.* (CM). **GUANAJUATO:** Guanajuato, *Dugès 460A* (GH). **QUERETARO:** Cercaina, *Basile 137* (CM); Querétaro, *Arsène 10432* (MO). **HIDALGO:** Ixmiquilpan, *Née s. n.*, (CM, isotype of *Argyrochaeta bipinnatifida*). **MEXICO D. F.:** San Angel, *Orcutt 3562* (CM, GH, MO); Mexico, *Orcutt 4102* (CM, GH, MO); near Guadalupe, *Pringle 9942* (GH, MO); near Atzcapotzolco, *Happ 151* (MO). **MICHOACAN:** vicinity of Morélia, *Arsène 8694* (CM, MO). **PUEBLA:** San Luis Tultitlanapa, *Brandegee s. n.* (UC); near Ascuña Villa, between Tehuacán and the Vera Cruz state line,

Norvell s. n. (GH); above Serdan, Cabecero, *A. J. Sharp 44991* (GH); near Calchicomula, *Rose & Hay 5795* (US); Mt. Orizaba, *Seaton 154B* (GH, US). **VERA CRUZ:** sandy soil of plain, 8,300 ft., near Guadalupe, Victoria, *Weaver 884* (GH); **GUERERRO:** vicinity of Balsas, *Lemon 71* (GH, US).

After my initial taxonomic studies of this entity, it appeared to connect so closely with *P. hysterophorus* that no more than varietal status could be accorded it. However, later, having *P. bipinnatifidum* in cultivation, characteristics at first overlooked became evident. The fact that *P. bipinnatifidum* proved to have $2n = 24$ chromosomes, the lowest number so far found in the genus, focused attention on this species. The short life-cycle, which could be completed in six weeks, seemed remarkable in view of our experience with *P. hysterophorus*, which required at least five months from seed to flower. In many other ways the growth characteristics of *P. bipinnatifidum* and *P. hysterophorus* proved to be distinctly different. For example, *P. bipinnatifidum* began producing an elongated axis from its initial stages of growth, ultimately resulting in a stem with well-spaced lower leaves, whereas *P. hysterophorus* always started with a shortened axis resulting in a rosette of basal leaves. The flowering stems appeared at a much later stage of development. The heads of the lower portion of the inflorescence are borne on shorter and stouter peduncles and the inflorescence is more crowded in *P. bipinnatifidum* than in *P. hysterophorus*. The bracts, either subtending or adjacent to the peduncles, are considerably developed in *P. bipinnatifidum* often being somewhat divided and equalling or exceeding the peduncle in length. Similarly disposed bracts in *P. hysterophorus* are entire and much reduced. Sometimes they are so reduced as to appear to be absent entirely.

The illustrations of *Villanova bipinnatifida* Ortega (l. c.) and of *Argyrochaeta bipinnatifida* Cavanilles (l. c.) are undoubtedly of the same species although based on different collections. Ortega's material was grown in the Madrid Botanical Garden from seed collected in Mexico by Sessé and was undoubtedly used in making the illustrations of Plate 6. Cavanilles, on the other hand, cited plants collected by Née at Ixmiquilpan, Mexico. I have seen a specimen of the Née collection from the Chicago Natural History Museum and it matches the Cavanilles plate very well. The printed date of the Ortega and of the Cavanilles publications is the same, 1797. There has been a problem in selecting the older of the two publications to provide the typifica-

tion of the name. Because of having seen an isotype from the Née collection upon which Cavanilles name was based, I was at first inclined to transfer Cavanilles name and some specimens were so annotated. However, there is strong evidence that the work of Ortega was published before that of Cavanilles, the most conclusive being the reference to Ortega's book by Cavanilles on pages 54 and 55 of the work cited. Ortega gave the distribution of *Villanova bipinnatifida* as Cuba and Mexico. It is almost certain that any Cuban plants he saw were *P. hysterophorus*.

12. **Parthenium glomeratum** Rollins, sp. nov.

Herbaceous perennial; stems few to numerous from a tap-root, prostrate to ascending, widely branching at base and above, often forming a compact clump, 1–4 dm. high, striate, pubescent with spreading simple trichomes; basal leaves pinnate or somewhat bipinnate, petiolate, 4–10 cm. long, pubescent on both surfaces with simple pointed multicellular trichomes, lobes variable, oblong to narrowly obovate; cauline leaves pinnate, lower petiolate, upper sessile, diminishing upward but not markedly so, pubescent; heads congested into small clusters; peduncles 2–5 mm. long; outer phyllaries broadly oblong to oval, pubescent above, ciliate with multicellular club-shaped trichomes, 2.5–3.5 mm. long, 1.5–2.5 mm. broad; inner phyllaries broadly obovate, ciliate, densely pubescent near upper margin, three-nerved, 2.5–3.5 mm. long and wide; corolla white, tube short, ligule erect, bilobed or sometimes trilobed, about 1 mm. high; stigma with equal lobes; achenes obovate, strongly rib-margined, sparsely papillose above dorsally and ventrally, 2.5–3.5 mm. long, 1.5–2 mm. wide; pappus of two petaloid scales, these erect to divaricate, slightly shorter than the corolla; disk-florets narrowly claviform, closely subtended but scarcely invested by truncate bracts, these densely covered with glandular trichomes at their apices.

Herba perennis; caulibus decumbentibus teretibus striatis pubescentibus 1–4 dm. altis; foliis inferioribus petiolatis hirsutis pinnatis vel bipinnatis; foliis superioribus sessilibus pinnatis; inflorescentiis glomeratis; involucri squamis ciliolatis; achaeniis obcompressis nigris 2.5–3.5 mm. longis, 1.5–2 mm. latis.

Bolivia and northern Argentina. **BOLIVIA:** Escayache bei Tarija, Tarija, Jan. 30, 1904, *K. Fiebrig 3017* (GH, type; CM, ILT, MO, isotypes); Bolivian plateau, 1891, *Bang 948* (GH, MO). **ARGENTINA:** Volcán, Jujuy, *Verano 2923* (ILT); La Quiaca, Yavi, Jujuy, *Meyer 4639* (ILT, also ILT nos. 33047 and 34348 from the same locality by the same collector); same locality, *Parodi 9612* (GH); Sierra de Lenta, Jujuy, *E. Budin 7460, 7467, 7468* (ILT); Cuesta del Obispo, Salta, *Meyer 12285* (ILT); Lizoite, Santa Victoria, Salta, *Meyer & Bianchi 33066* (ILT); Tilcara, Tilcara, *Cabrera 7714* (GH).

An intensive study of the herbarium material of the *P. hystero-*

phorus complex from South America leaves much to be desired. It seems certain that *P. hysterophorus* itself occurs mainly at lower elevations from sea-level to one or two thousand feet and is an established weed as in other portions of its range. On the other hand, the material placed in *P. glomeratum* comes from elevations of nine to twelve thousand feet and is undoubtedly native. There are perplexing variants in this group which may represent other species, or possibly variant types that have arisen through hybridization. Such problems require the careful study of field-populations for their solution and we have not had the opportunity to make such studies.

P. glomeratum is readily distinguished from *P. hysterophorus* because of the congestion of the heads into discrete clusters, the short peduncles, the perennial habit and the low decumbent branching stems. Actually, the species appears to be more closely related to the Mexican *P. bipinnatifidum* than to *P. hysterophorus*. However, *P. bipinnatifidum* is strictly an annual plant with bipinnate leaves and less congested heads.

Section III. Partheniastrum DC.

Parthenium, sect. I. *Partheniastrum* DC. Prod. V: 532. 1836.

Plants herbaceous; perennial with large over-wintering roots; leaves large and entire or variously dentate; pollen white; pappus of 2–3 weak, linear awns. Type-species, *P. integrifolium* L.

13. **Parthenium hispidum** Raf.

Perennial herb; roots often laterally branched to form underground runners; stems pilose-hispid, unbranched below, striate, 2–4 mm. in diameter, 2–8 dm. high; basal leaves long-petioled, blade pilose-hispid, broadly lanceolate to ovate, crenate to somewhat dentate, 6–20 cm. long, 5–10 cm. wide, petiole 6–15 cm. long; lower cauline leaves similar to basal, sometimes with an interruptedly winged petiole, cauline leaves sessile, auriculate to scarcely so, ovate to ovate-lanceolate, crenate to dentate, pilose-hispid particularly along the veins; heads few to many, corymbose, densely pubescent, 4–7 mm. high, 6–10 mm. broad in var. *typicum*, 3–5 mm. high, 4–6 mm. broad in var. *auriculatum;* outer phyllaries ovate to broadly oblong, obtuse to nearly acute, usually apiculate, densely pilosulous toward apex, ciliate, inner obovate, rounded at apex, scarious, ciliate; rays erect, white, bluntly two-lobed to emarginate, 1.5–3 mm. long; disk-florets numerous, white, upper portions densely matted with white trichomes; achenes obovate, obcompressed, blackish, 3–5 mm. long, pubescent above and on the inner surface with multicellular clavate trichomes, pappus of 2 erect rather weak awns.

Key to the Varieties

Heads 4–7 mm. high, 6–10 mm. broad; basal leaf-blades ovate-lanceolate to lanceolate; middle and lower cauline leaves usually with a non-winged petiole, Missouri and Kansas to Louisiana and Texas, apparently adventive in Michigan.....13a. var. *typicum.*

Heads 3–5 mm. high, 4–6 mm. broad; basal leaf-blades ovate or slightly narrower; middle and lower cauline leaves frequently with an interruptedly winged petiole, mountains and Piedmont of Virginia and North Carolina.....13b. var. *auriculatum.*

13a. **Parthenium hispidum,** var. **typicum**

P. hispidum Raf., New Fl. N. Am. II. 35. 1837.

P. repens Eggert, Catal. Pl. St. Louis. p. 16. 1891.

Missouri and Kansas to Louisiana and eastern Texas. Fig. 17. Apparently adventive in Michigan. Representative specimens:—**MICHIGAN:** right-of-way of Grand Trunk Railroad, 2 mi. west of Schoolcraft, Kalamazoo Co., *Hanes 4027 & 4511* (GH); same locality, *Hermann 9059* (GH, MO, CM). **MISSOURI:** near St. Louis, May 23, 1879, *Eggert s. n.* (CM, isotype; MO, type of *P. repens* Eggert); St. Louis, *Sherff 248* (GH, CM); Meramec Highlands, St. Louis Co., June 25, 1904, *Gleason s. n.* (GH); Allenton, St. Louis Co., July 25, 1890, *Letterman s. n.* (DS); southwest of Pacific, Jefferson Co., *Steyermark 1881* (CM); 5 mi. nw. of Freeburg, Osage Co., *Steyermark 27685* (CM); 3 mi. northeast of Edgar Springs, Dent Co., *Steyermark 25431* (CM, MO); Montier, Shannon Co., *Bush 189* and *375* (GH, MO); Mansfield, Wright Co., *Lansing 3180* (CM); 4 mi. southeast of Chadwick, Christian Co., *Steyermark 22984* (CM, MO); Carthage, Jasper Co., *Palmer 3978* (GH, MO); near Eagle Rock, Barry Co., *Palmer 30395* (GH, MO). **ARKANSAS:** Beaver, Carroll Co., *Palmer 5591* (MO); near Hazen, Prairie Co., *H. E. Wheeler 59* (CM, UC); Fulton, Hempstead Co., *Palmer 8062* (CAS, MO); Carlisle, Lonoke Co., *Demaree 17584* (CM, MO); Portland, Ashley Co., *Demaree 14749* (CAS). **KANSAS:** Elk Co., Aug. 20, 1897, *G. L. Clothier,* (GH, MO, US); Chautauqua Co., May 7, 1897, *A. S. Hitchcock 1086* (GH, MO, US). **LOUISIANA:** dry uplands between Shreveport & Morringsport, Caddo Parish, *Brown 6077* (GH); highlands, near Shreveport, *Jos. Gregg* (MO). **OKLAHOMA:** near Page, Leflore Co., *Blakley 1452* (DS, GH). TEXAS: without locality, *Leavenworth s. n.* (GH); north of Buchanan, Bowie Co., June 13, 1898, *Eggert s. n.* (MO).

13b. **Parthenium hispidum,** var. **auriculatum** (Britton) comb. nov.

P. auriculatum Britton in Britton & Brown, Illus. Fl. 3: 521. 1898.

P. integrifolium L., var. *auriculatum* (Britt.) Cornelius ex Cronquist, in Rhodora 47: 399. 1945.

Mountains and piedmont of Virginia and North Carolina. Representative specimens:—**VIRGINIA:** Cedar Creek, Frederick Co., *Hunnewell 11245* (GH); Frederick Co., *W. E. A. Aiken s. n.* (UC); near Cedar Creek, Shenandoah Co., *Hunnewell 11955* (GH); near Clarksville, Mecklenburg

Co., *Ashe 240* (NY, type); bluffs above Roanoke River at Dixie Caverns, Roanoke Co., *Wood 3633* (GH); near Blacksburg, Montgomery Co., *Hermann 10604* (GH); 2½ mi. w. of Shawsville, Montgomery Co., *Massey 2016* (GH); Wytheville, Wythe Co., Oct. 1878, *Howard Shriver s. n.* (DS).

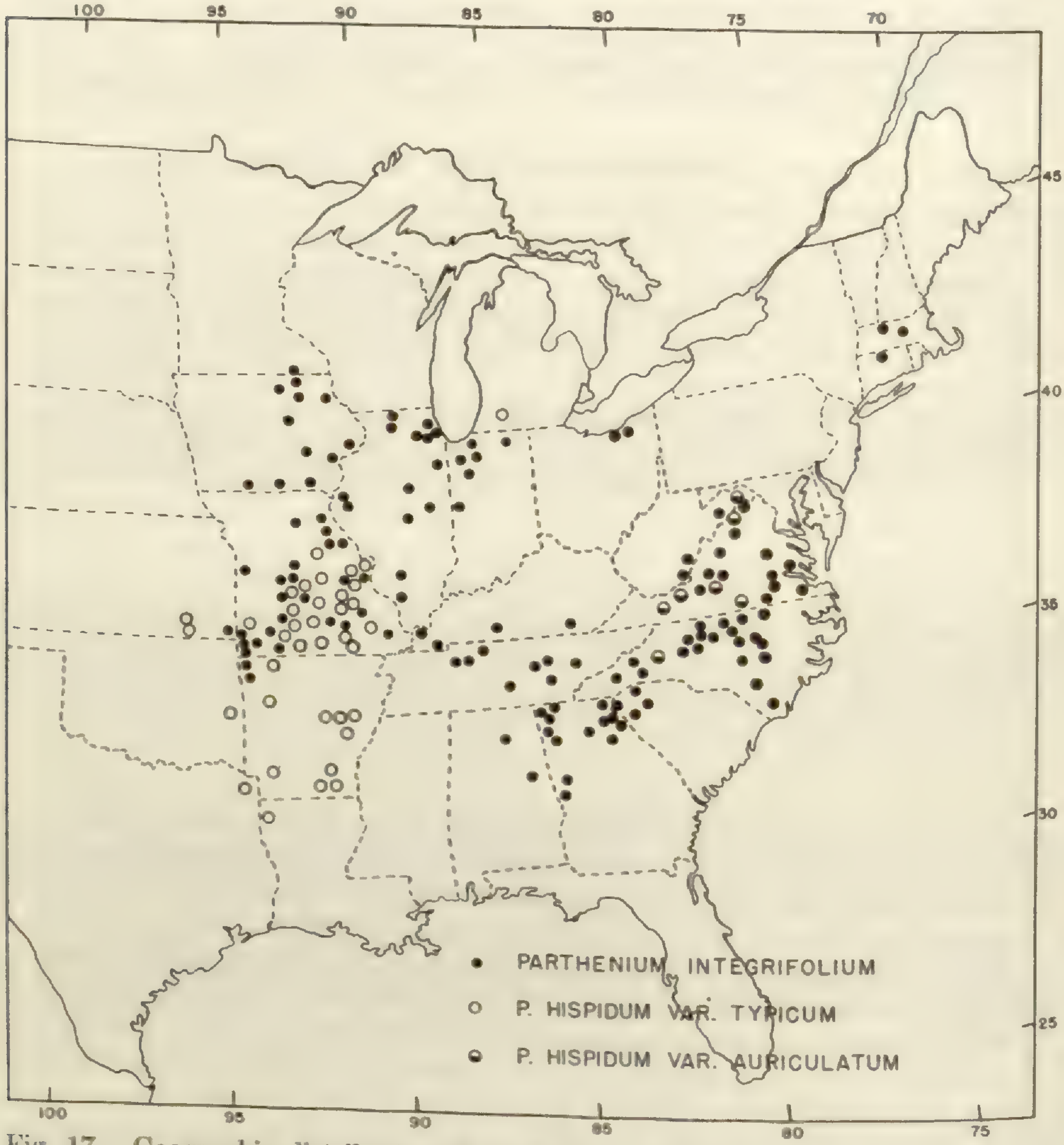

Fig. 17. Geographic distribution of *Parthenium hispidum* and *P. integrifolium*.

NORTH CAROLINA: 5 mi. southeast of Morganton, Burke Co., *O. M. Freeman s. n.* (US).

P. integrifolium and *P. hispidum* are unquestionably very closely related and doubtless came from the same original stock. It is suspected that polyploidy is involved as a contributing factor to the variation found in both species. This assumption

is based upon the fact that, according to size of parts and organs, plants of each species fall into two size-classes. This is particularly marked in *P. hispidum*, where the typical variety has distinctly larger parts than var. *auriculatum*. Judging by the size-differences between diploids and tetraploids of other species of *Parthenium* where the chromosome-situation is definitely known, var. *typicum* stands at about a tetraploid level compared to var. *auriculatum* if the latter is assumed to be diploid. Material from Missouri of var. *typicum* was found to have $2n = 72$ chromosomes, but var. *auriculatum* has not been available for chromosome-counts.

It seems clear that var. *auriculatum* should be associated with *P. hispidum* rather than *P. integrifolium* (following Cronquist, l. c.), although in some cases this entity is somewhat intermediate between the two species. However, it has the harsh pubescence and auriculate cauline leaves of *P. hispidum*, the most important characters separating the latter from *P. integrifolium*.

The ranges of typical *P. hispidum* and *P. integrifolium* overlap in much of Missouri and it is quite probable that hybridization occurs between these species in several places. That such is definitely the case has not been shown, but there are certain specimens that are difficult to assign to one species or the other. Aside from the differences between *P. hispidum* and *P. integrifolium* elaborated in the key, there are other somewhat variable characteristics that may be utilized in attempting to place a given specimen. The corymbs of *P. hispidum* are more compact and the heads are usually much larger than in *P. integrifolium*. The leaves of the latter are proportionately narrower, are less regular and the teeth more apt to be somewhat acute than in *P. hispidum*, where the margins are obtuse, quite often becoming regularly crenate.

14. **Parthenium integrifolium** L.

Parthenium integrifolium L., Sp. Pl. II: 988. 1753.
P. amplectens Raf., New Fl. N. Am. II. 26. 1837.
P. angustifolium Raf., ibid. p. 25.
P. dillenianum Raf., ibid. p. 26. a provisional name.
P. elliotanum Raf., ibid. p. 26. a provisional name.
P. pumilum Raf., ibid. p. 25.
P. sinuatum Raf., ibid. p. 25. (?).

Perennial herb; stems one to several from a deep sometimes bulb-shaped root, 3–10 dm. high, corymbosely branched above, fairly stout, striate, sparsely pubescent to glabrous below, more densely pubescent

above; basal leaves long-petioled, coarsely dentate, blade ovate to lanceolate, decurrent on the petiole, scabrous, prominently veined, 4–12 cm. wide, 10–20 cm. long; lower cauline leaves petiolate, upper sessile, not auriculate, ovate to ovate-lanceolate, subtending the branches; heads numerous, corymbose, densely pubescent, 3–5 mm. high, 4–6 mm. broad; outer phyllaries ovate to slightly obovate, usually apiculate, densely pilosulous toward apex; inner phyllaries broadly obovate, rounded at apex; rays erect, white, ca. 2 mm. long; disk-florets white, anthers exserted during dehiscence, stigma cylindrical but not capitate; achenes obovate, obcompressed, blackish, pubescent toward apex only, pappus-awns weak, linear, erect, 2 lateral, 1 ventral, the ventral awn sometimes vestigial.

Virginia to Alabama, Arkansas and southern Minnesota. Fig. 17. Adventive in Massachusetts. Infrequently cultivated as a garden plant. **MASSACHUSETTS:** In mowing-land, No. Orange, *Mrs. H. A. Ward s. n.* (GH); railroad embankment, Jamesville, Worcester Co., *N. P. Woodward s. n.* (GH, NEBC). **CONNECTICUT:** cultivated ground, Waterford, Hartford Co., *C. B. Graves s. n.* (NEBC). **VIRGINIA:** Hayfields, Frederick Co., *Hunnewell 10740* (GH); Mount Marshall, Page Co., *Allard 777* (GH); 3 miles north of Williamsburg, James City Co., *Menzel 29* (GH); Richmond, *J. R. Churchill s. n.* (GH); Kilbry, Nansemond Co., *Fernald, Long and Fogg 5119* (GH); Blackwater School, Prince George Co., *Fernald, Long and Smart 5945* (GH); Homeville, Greensville Co., *Fernald and Long 8500* (GH); near Cold Spring, Augusta Co., *Allard 3036* (GH); Bedford Co., *A. H. Curtiss 3447* (MO, US); 2 mi. northwest of Salem P. O., Roanoke Co., *C. E. Wood, Jr. 2502* (GH). **WEST VIRGINIA:** near Wardensville, Hardy Co., *Berkley 1597* (MO); White Sulphur Springs, Greenbrier Co., *M. S. Franklin s. n.* (GH); 1 mile south of White Sulphur Springs, Greenbrier Co., *L. F. and F. R. Randolph 1282* (GH); Red Sulphur Springs, Monroe Co., *Hunnewell 12983* (GH). **NORTH CAROLINA:** near Enfield, Halifax Co., *Godfrey 5182* (GH); Oxford, Granville Co., *Godfrey 5933* (GH); 3 miles west of Sims, Wilson Co., *Wiegand and Manning 3340* (GH); Newton Grove, Wayne Co., *Godfrey 4237* (GH); Raleigh, Wake Co., *Godfrey 3964* (GH); near Lilington, Harnett Co., *Godfrey 5675* (GH); Elizabethtown, Bladen Co., *L. F. and F. R. Randolph 1048* (GH); near Bolivia, Brunswick Co., *Godfrey and Shunk 4220* (GH); Yanceyville, Caswell Co., *Godfrey 5615* (GH); Duke Forest, Durham Co., *Musgrove s. n.* (UC); Stokes Co., *Schallert s. n.* (UC); Iredell Co., *Hyams s. n.* (DS); Piedmont, Rowan Co., *Heller 14157* (DS, MO); Ferguson Knob, Polk Co., *Peattie 838* (CM); Asheville, Buncombe Co., *Hunnewell 9945* (GH). **SOUTH CAROLINA:** Caesar's Head, Greenville Co., *Redfield 5615* (MO); Baldwin, Laurens Co., *Davis s. n.* (DS, MO); Anderson, Anderson Co., *Davis s. n.* (DS, MO, UC); Clemson College, Oconee Co., *House 2346* (US); Seneca, Oconee Co., *McCarthy s. n.* (GH). **GEORGIA:** 8 miles southwest of Hartwell, Hart Co., *Wiegand and Manning 3342* (GH); Rabun Bald, Rabun Co., *Duncan 2655* (GH); Summerville, Chattooga Co., *Pollard and Maxon 447* (GH); Pine Mountain, Meriwether

Co., *Eyles 7206* (GH); Warm Springs, Meriwether Co., *Tracy 8940* (GH, MO); 8 mi. west of Manchester, Harris Co., *Cronquist 5251* (GH, Ga). **ALABAMA:** without locality, *Buckley s. n.* (GH); Mellerville, Clay Co., *Pollard and Maxon 177* (GH); St. Bernard, Cullman Co., *W. Wolf s. n.* (UC). **OHIO:** Geauga Co., *Ford 1435* (GH); Mayfield Road near Cleveland, Cuyahoga Co., *Greenman 1345* (DS, GH, MO). **INDIANA:** Rome City, Noble Co., *E. B. Uline s. n.* (CM); near Cedar Lake, Starke Co., *A. W. Brady s. n.* (UC); near Goodland, Jasper Co., *Welch 6108* (GH, UC); north of Reynolds, White Co., *Friesner 14521* (UC); southwest of Perrysville, Vermillion Co., *Friesner 19408* (GH). **KENTUCKY:** East of Cumberland Falls, Whitley Co., *McFarland and James 24* (MO, UC); Bowling Green, Warren Co., *S. F. Price s. n.* (CM); between Murray and Pine Bluff Ferry, Calloway Co., *Smith and Hodgdon 4203* (CM, GH); near Paducah, McCracken Co., *E. J. Palmer 17944* (MO). **TENNESSEE:** Rugby, Morgan Co., *A. S. Persival s. n.* (CM); Mayland, Cumberland Co., *Harbison and Porter 3130* (UC); White Bluffs, Dickson Co., *Svenson 4406* (GH); near Decatur, Meigs Co., *Sharp & Underwood 2306* (MO); 5 miles north of Waverly, Humphreys Co., *Harger 7899* (GH). **WISCONSIN:** Silvania, *Mrs. J. M. Milligan, s. n.* (US); Shutesbury, July 3, 1883, *W. H. Manning s. n.* (GH). **ILLINOIS:** Naperville, *Umbach 3875* (GH); Stony Island, Cook Co., *Smith 6036* (GH, MO, UC); Chicago, *Moffatt 540* (UC); Fountaindale, Winnebago Co., *M. S. Bebb s. n.* (GH); Aurora, Kane Co., *Boyce 1394* (GH); Oregon, Ogle Co., *S. G. Mason s. n.* (UC); Champaign, Champaign Co., *Gleason 174* (GH); near Urbana, Champaign Co., *Jones 13917* (UC); Normal, McClean Co., *B. L. Robinson s. n.* (GH); Bloomington, McClean Co., *B. L. Robinson s. n.* (GH); 2 miles west of Decatur, Macon Co., *Clokey 2398* (UC). **MISSOURI:** near Clarksville, Pike Co., *Davis 7594* (DS, MO); Kimmswick, Jefferson Co., *J. R. Churchill s. n.* (GH); Cooper Co., *Bush 14791A* (MO); Allenton, *G. W. Letterman s. n.* (GH, Ph); near Ironton, Iron Co., *Palmer 18089* (GH, MO); Montier, Shannon Co., *Bush 159* (GH, MO); McDonald Co., *Bush 2024* (GH). **ARKANSAS:** Benton Co., *Plank s. n.* (MO); Greenland township, Washington Co., *Turner 2801* (GH, MO). **MINNESOTA:** LeRoy, Mower Co., in 1861, *T. J. Hale s. n.* (GH); **IOWA:** Winneshiek Co., *Hayden, Tolstead and Strunk, s. n.* (GH, MO); Fayette Co., *Fink 243* (GH, US); LeClaire, Scott Co., *Le Buhn 523* (GH, MO); New Hampton, Chickasaw Co., *Pammel 488* (GH); Appanoose Co., *Fitzpatrick 13714* (GH); Muscatine, *Ball 1539* (MO); Decatur Co., *J. P. Anderson s. n.* (MO). **KANSAS:** 6 mi. east of Baxter Springs, Cherokee Co., *McGregor 1676* (GH).

In its northwestern range, *P. integrifolium* is a prairie plant and was undoubtedly abundant at one time in the tall-grass prairie region of the United States. Since most of the prairie area is now intensively cultivated, the species is restricted largely to prairie relics in the middle and northern portions of its range.

East and south of the main prairie region, *P. integrifolium* is found on dry sites in open fields and glades. The species has been cultivated to a limited extent both in Europe and in America and has occasionally escaped from gardens. However, it has never become a favored ornamental plant.

There is considerable size-variation in *P. integrifolium*. Some specimens have larger heads and flower-parts than others. Such differences in size as those observed are linked in some other species of *Parthenium* with genomic differences in chromosome-number. However, I have not been able to investigate this problem in *P. integrifolium*. A progeny-planting of a single plant originally from northwestern Indiana was found to possess $2n = 72$ chromosomes.

Frequently the roots of this species are enlarged and bulb-shaped with thick elongated secondary branches leading from the enlarged portion. There is a slight tendency toward rhizome-formation in *P. integrifolium*, but this tendency is not a charactistic of the species as is the case with *P. hispidum*. As mentioned in a discussion under the latter species, *P. integrifolium* and *P. hispidum* probably hybridize readily in the area of Missouri and Arkansas where their ranges overlap. Most of the puzzling somewhat intermediate specimens encountered in herbaria could be explained on such an assumption.

Section IV. Bolophytum (Nutt.) T. & G.

Parthenium, sect. 3, *Bolophytum* T. & G., Fl. N. Am. II: 285. 1842.
Bolophyta Nutt., Trans. Am. Phil. Soc. VII: 348. 1841.

Plants caespitose, dwarfed; leaves entire, crowded, small; heads solitary; pappus paleaceous, often fused with the corolla-tube to form winged margins. Type-species, *P. alpinum* (Nutt.) T. & G.

15. **Parthenium ligulatum** (Jones) Barneby

Parthenium ligulatum (Jones) Barneby, Leaflets West. Bot. V: 20. 1947.
P. alpinum (Nutt.) T. & G., var. *ligulatum* M. E. Jones, Contrib. West. Bot. 13: 16. 1910.

Caespitose perennial forming dense mats 2–8 inches across; root deep and highly branched, somewhat woody; plants branching in the caudex mostly below the soil surface, each branch covered with scale-like leaf-bases and matted long white multicellular trichomes, branches 1–3 cm. long; whole plant less than 2 cm. above ground; leaves tufted, spatulate, obtuse, obscurely 1-nerved, silvery from a dense covering of simple stiffish trichomes, entire, 0.5–2 cm. long, 2–4 mm. wide; heads solitary at the ends of the caudex-branches, sessile, stramineous, 5–7 mm. high, ca.

5 mm. broad; outer phyllaries oblong, tapered toward apex, next inner phyllaries elliptical to slightly broader, 4–6 mm. long, densely pubescent toward apex of back surface, otherwise nearly glabrous; achenes broadly oblanceolate, densely pubescent, 4–5 mm. long, 2–3 mm. wide; pappus paleaceous, free or sometimes fused with corolla-tube to form winged margins; corolla white, tube ca. 1 mm. long, constricted at apex, ligule elliptical, 1–2 mm. long, emarginate; style deeply cleft; pollen white. $2n = 36$.

Northwestern Utah and adjacent Colorado. Specimens examined:— **UTAH:** 5 mi. west of Bitter Creek, Watson-Ouray Road, Uintah Co., *Graham 8991* (CM, GH, MO, UC); light-colored shale knoll, pinon-juniper assoc., 3 mi. east of head of Buck Canyon, Ouray-Watson Road, Uintah Co., *Rollins 3087* (DS, GH, MO); similar habitat, 5 miles north of McCoy's, Ouray-McCoy's Road, Uintah Co., *Rollins 3088* (DS, GH); 27 miles southeast of Ouray, Uintah Co., *Ripley & Barneby 8746* (DS); 10 miles south of Theodore (now Duchesne), Duchesne Co., May 19, 1908, *M. E. Jones s. n.* (CAS, CM, DS, GH, MO, UC, isotypes); light-colored limey shale, high on the slopes of the canyon wall, near Indian Creek, 4 miles southwest of Duchesne, Duchesne Co., *Rollins 3093* (DS, GH); dry rocky places, San Rafael Swell, Emery Co., *Cottam 5259* (US). **COLORADO:** 17 miles northwest of Rangely, Rio Blanco Co., *Ripley & Barneby 8742* (DS).

The distributional area occupied by *P. ligulatum* is apparently governed in large part by its being closely adapted to light-colored shale-like outcrops of the Green River Eocene formation. In three locations in the Uinta Basin of Utah, where this species was studied in some detail, it was found only on restricted sites formed by the outcropping of what appeared to be a gypseous shale. The plants, though abundant, did not venture from these sites, nor were they to be found on likely habitats in the area unless the shale was present. From my observations in the Uinta Basin, the actual number of such outcrops appeared to be relatively few and the extent of each area where they occurred was limited. This probably accounts for the fact that previous to my recent field-trips into northeastern Utah to study *P. ligulatum*, and those of Ripley and Barneby in the same area, this species had been collected only three times. It was found only once by Graham (1937) who did intensive field-work in the area where it grows.

There is an array of characters which separate *P. ligulatum* from *P. alpinum* and I believe it is a mistake to consider the two as varieties of a single species. The presence of a pronounced ligule on the fertile florets of *P. ligulatum* is emphasized in the

name, but this character is by no means the most important. In this species, the tube of the corolla is so constricted at the apex that there appears to be barely room for the style to protrude through the opening. In contrast, the corolla-tube of *P. alpinum* is not at all constricted above and appears to flare slightly. The heads of the latter species are broader than they are high, but in *P. ligulatum*, they are higher than broad. Also, the leaves are quite different in the two. In *P. alpinum*, they are linear to linear-spatulate and have a prominent midrib while in *P. ligulatum* the midrib is obscure and the leaves are definitely spatulate. I had independently arrived at the conclusion that *P. ligulatum* was a distinct species before Barneby made the nomenclatural change in 1947.

16. **Parthenium alpinum** (Nutt.) T. & G.

Caespitose perennial, acaulescent, caudex branched and terminating in tufts of crowded leaves; branches fusiform, covered with remnants of old expanded leaf-bases, and possessing, mostly at their apices, dense tufts of long white unbranched multicellular trichomes; leaves entire, linear to linear-spatulate or oblanceolate, silvery-canescent from a dense covering of stiff, simple, multicellular, pointed trichomes, rather prominently one-nerved or sometimes with two lateral obscure nerves, acute to obtuse, 1.5–4 cm. long, 1.5–6 mm. wide; heads solitary, one to several on each branch, sessile or pedunculate,4–7 mm. high, 5–10 mm. broad; outer phyllaries suborbicular to broadly ovate, pubescent on the back, inner phyllaries imbricate to broadly orbicular, membranaceous, 3–5 mm. long, pubescent toward apex on the back surface; achenes obcompressed, oblong, cuneate, pubescent, 3–4 mm. long, 1.5–2 mm. wide, often fringed on the sides by thin paleaceous marginal extensions of the pappus; pappus variable, usually of two paleaceous triangular to lanceolate, often fimbriate, scales nearly as long as the truncate corolla-tube, pappus often fused with the lower portion of the tube, a third ventral awn sometimes present, ligule wanting.

Key to the Varieties

Heads pedunculate to sessile or nearly so; peduncles less than 1 cm. long, plants of Wyoming . . . . . 16a. var. *typicum*.
Heads pedunculate; peduncles 1–3 cm. long, plants of Colorado . . . . . 16b. var. *tetraneuris*.

16a. **Parthenium alpinum,** var. **typicum**

Parthenium alpinum (Nutt.) Torrey & Gray, Fl. N. Am. II: 285. 1842. *Bolophyta alpina* Nuttall in Trans. Am. Phil. Soc. VII: 348. 1840.

For over a century known only from the type collection "in the Rocky Mountains, towards the sources of the Platte, in about lat. 42 degrees, on shelving rocks at the summit of a lofty hill, near the place called the

"Three Buttes" by the Canadians, 7000 feet above the level of the sea." *Nuttall s. n.* (GH, Ph, isotypes). Recently collected in **WYOMING** at the following locations: on white shale ridges and cobblestone bluffs, Alcova, Natrona County, July 2, 1947, *H. D. Ripley & R. C. Barneby 8945* (DS); steep grade 4 miles west of Alcova, Natrona Co., May 9, 1948, *C. L. Porter 4425* (GH); 3 mi. west of Lusk, Niobrara Co., June 11, 1948, *Ripley & Barneby 9114* (GH); 5 miles west of Lusk, Niobrara Co., April 23, 1949, *C. L. Porter 4855* (GH).

16b. **Parthenium alpinum,** var. **tetraneuris** (Barneby) comb. nov.

P. tetraneuris Barneby in Leafl. West. Bot. V: 19–20. 1947.

Heads pedunculate, peduncle 1–3 cm. long. $2n = 72$.

COLORADO: white shale bluffs of the Arkansas River, east of Portland, Fremont Co., June 1, 1946, *H. D. Ripley & R. C. Barneby 7662* (CAS, type; GH, isotype); Turkey Creek, near to its confluence with the Arkansas River, Pueblo Co., May 23, 1947, *Ripley & Barneby 8305* (DS); 3 miles northwest of Pueblo, Pueblo Co., May 23, 1947, *Ripley & Barneby 8303* (GH, DS).

As Goodman (1943) pointed out, the type-locality of typical *P. alpinum* has not been definitely determined from published records. Nuttall obtained his specimens while traveling with the Wyeth Expedition which left St. Louis, Missouri, in the spring of 1834 bound for Fort Vancouver, Oregon. Using the available evidence, Goodman concluded that the type-station may be either in eastern Idaho or central Wyoming, the latter area being the more likely of the two. Now that the species has been discovered in south central Wyoming by Ripley and Barneby, and by Porter (1949), it seems reasonably certain that the type-station is in that general area. The specimens collected near Alcova, Wyoming, are very similar to the Nuttall plants and undoubtedly belong to the same entity. Barneby's (1947) prediction that typical *P. alpinum* would be found growing in central Wyoming curiously paralleled a similar suggestion I had recorded in manuscript at about the same time. Our reasoning was similar in that likely habitats were abundant "towards the sources of the Platte", but were practically absent in eastern Idaho. Also, on the date (June) when Nuttall collected *P. alpinum*, he must have been in Wyoming.

In studying the available material of typical *P. alpinum* and that of *P. tetraneuris*, Barneby, I can find little reason for keeping the two as distinct species. The differences in leaf-width, nervation of the leaves, phyllary-size, achene-size and the achene-margins emphasized by Barneby, while seemingly valid for the

two type-series, break down when the recent collections of material are fully examined. We find plants from Colorado with leaves as narrow as those on the Wyoming plants and these possess but a single nerve. Other plants from Wyoming with broader leaves are obscurely three-nerved. The achene- and phyllary-size seem not to be far different in the plants from the two areas and the achenes of some Wyoming plants are distinctly winged. There are minor differences between the plants from the two areas, but these are scarcely on the species-level. It is my conclusion that the two entities should be treated as varieties of the same species.

There is some variation between the different collections of *P. alpinum*, var. *tetraneuris* with respect to the shape of the pappus-scales and the amount of their adnation to the corolla-tube. The achenes examined from plants of *Ripley and Barneby 7662* and *8305* have broad, often more or less fimbriate scales which usually show some degree of adnation to the corolla-tube. Sometimes one of the two scales is fused and the other free. However, in *Ripley and Barneby 8303*, the scales are somewhat pointed at the apex and are rarely fused with the corolla-tube. The variations noted appear not to be correlated with other characters and are probably not taxonomically significant. Similar variations in the pappus have been found in the specimens of typical *P. alpinum* collected near Lusk, Wyoming. In a random sample of 24 achenes provided for study by Professor C. L. Porter, from near Alcova, Wyoming, over half of them showed the lateral pappus-awns to be fused with the corolla-tube. In less than half, the tips were free. In all cases the lateral margins of the corolla were more or less winged, the wings extending along the upper half of the achene-margin. A ventral awn was present upon 9 achenes, but could not be seen in the other 15.

Species Excluded from Parthenium

P. annuum (L.) Crantz, Inst. Rei Herb. I. 345. 1766 = *Iva annua* L.
P. frutescens (L.) Crantz, Inst. Rei Herb. I. 345. 1766 = *Iva frutescens* L.
P. luteum, Spreng. Nov. Prov. Hort. 31, 1819 = *Guizotia abyssinica*. cf. Index Kewensis. Certainly not a *Parthenium*.
P. matricaria Gueldenst. Reisen II. 25 = *Chrysanthemum Parthenium*. cf. Index Kewensis. Certainly not a *Parthenium*.

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A CYTOTAXONOMIC STUDY OF THE GENUS DISPORUM IN NORTH AMERICA[1]

QUENTIN JONES

The genus *Disporum* of the *Liliaceae* was first recognized by Salisbury (1812) who published the illegitimate name, *Disporum pullum*, based on Ker-Gawler's (1806) *Uvularia chinensis*. Merrill (1919) discovered that Loureiro's (1790) *Fritillaria cantoniensis* was actually a *Disporum* and he effected the transfer of this, the type-species, to *Disporum*.

The first monograph of *Disporum* (*Eudisporum* of the present paper) was published by D. Don (1841a). He recognized eight species, all Asiatic. At the same time, Don (1841b) erected a new genus, *Prosartes*, based on *Streptopus lanuginosus* and including *Prosartes Menziesii* (= *Disporum Smithii*). Don distinguished the genus *Prosartes* from *Disporum* on the basis of three principal differences: (1) innate anthers in *Prosartes* as contrasted with adnate anthers in *Disporum*, (2) nearly entire styles in *Prosartes* as opposed to deeply divided styles in *Disporum*, (3) pendulous seeds in *Prosartes*, ascending seeds in *Disporum*.

J. G. Baker (1875) treated *Disporum* and *Prosartes* separately. He recognized five species of *Disporum*, all Asiatic, and three species of *Prosartes*, all North American. Baker considered *Disporum Hookeri* var. *Hookeri* and *D. Hookeri* var. *trachyandrum* (as treated here) as varieties of *D. lanuginosum* and gave no taxonomic recognition to the present *D. Hookeri* var. *oreganum*. He did not account for *D. maculatum*.

The last and most inclusive monograph of *Prosartes* was that of Sereno Watson (1879). He recognized seven species, treating *D. Hookeri* var. *Hookeri*, *D. Hookeri* var. *oreganum*, and *D. Hookeri* var. *trachyandrum* of the present treatment as distinct species. In distinguishing the species, he divided the genus into two groups on the basis of 3-cleft and entire stigmas.

Bentham and Hooker (1883) did not recognize the genus *Prosartes*, but included the North American species in the here-

[1] Condensed, and with minor changes effected, from a thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at the State College of Washington in June, 1950.

tofore Asiatic genus *Disporum*. Their principal reason for this reduction was the orientation of the ovules in *D. trachycarpum*. In this species the ovules are oriented in a horizontal position from the axile placentae and the relative position of raphe and micropyle is the same as in the ascending ovules of the Asiatic species. They reported this same condition in one of the Himalayan species, an observation which the writer has been unable to confirm. Since habit and all other characters, according to them, conformed in the two series, they concluded that generic separation was unjustified. Subsequent authors have followed this concept of generic limits.

It soon became apparent in the course of this study that the two series do not conform in habit and all other characters. Indeed, the two groups are rather strikingly dissimilar in general appearance and the dissimilarity is emphasized by detailed comparisons. It is true that the difference in the orientation of the ovules alone does not provide a sharp distinction, but there are other important features that do. Some of the more constant differences are tabulated below:

Eudisporum	Prosartes
1. Berry dark blue to black.	1. Berry reddish or straw-colored.
2. Herbage glabrous throughout.	2. Herbage more or less pubescent.
3. Ovules ascending with the micropyle directed downward, the raphe ventral.	3. Ovules pendulous with the micropyle directed upward, the raphe ventral, or horizontal with the micropyle below the funiculus.
4. Inflorescence often appearing lateral because of the continued growth of a branch from the second node below the inflorescence.	4. Inflorescence strictly terminal.
5. Perianth-segments spurred below, often conspicuously so.	5. Perianth-segments at most slightly gibbous below.
6. Stigma commonly deeply 3-parted.	6. Stigma entire or only slightly 3-cleft.
7. Leaves commonly lance-linear or linear.	7. Leaves rarely lance-linear or linear.
8. Confined to southeastern Asia.	8. Confined to North America.

Of the characters listed above, the difference in fruit color is absolutely constant. The ovary of the Asiatic *Eudisporum* never passes through a red color phase but is dark blue early in development. Glabrosity is constant in *Eudisporum* and there are no species in *Prosartes* that lack pubescence entirely, although occasional individuals of *D. trachycarpum* and *D. Smithii* approach glabrosity. The difference in ovule orientation is weak-

ened as a distinguishing characteristic by the condition found in *D. trachycarpum* and *D. maculatum.* In these two species the ovules are oriented in a horizontal position and the raphe-micropyle relationship is that of *Eudisporum* rather than of *Prosartes.* No species of *Prosartes* has the inflorescence appearing lateral, but such a condition is common in the species of *Eudisporum.* The other distinctions are mainly differences in degree only but support the more constant features.

It is apparent from these comparisons that there are two natural groups of species in *Disporum,* one group confined to southeastern Asia and the other to North America. These two groups are distinct enough, morphologically and geographically, to be considered as separate genera, but at the same time they appear to be more closely related to each other than to any other group. Divergence has reached a level where the groups could be considered either as genera or as well defined sections of a single genus. In the present treatment they are considered as sections, thus preserving the nomenclature that has become familiar through long usage.

This revision deals only with the section *Prosartes,* in which the following entities are recognized:

1. *D. maculatum.*
2. *D. trachycarpum.*
3. *D. Smithii.*
4. *D. lanuginosum.*
5. *D. Hookeri* with the varieties *Hookeri, oreganum,* and *trachyandrum.*
6. *D. parvifolium* (Probably a hybrid between *D. Hookeri* var. *Hookeri* and *D. Smithii,* but this needs verification. For the present it is a morphologically recognizable entity identified with this binomial).

Morphology

Underground parts. The genus is characterized by the presence of a short, slender rhizome with numerous fibrous roots arising from it. This rhizome is usually eight to twelve centimeters beneath the surface of the ground.

Stem. A single erect stem rises from one end of the rhizome each year. The stem may be flattened and ridged to terete and nearly smooth. Young stems may be quite pubescent the full length, but mature stems are usually glabrate, at least below. The lower naked portion of the stem is about equal in length to the upper leafy portion.

LEAVES. The leaves are variable in size and shape throughout the section *Prosartes* and even within a species. In size they range from two to over fifteen centimeters in length and, in shape, from lance-linear to broadly ovate. The shape of leaf-apices is fairly constant within a species and can be used within limitations as a diagnostic character. The lowermost leaves, those below the first branch, are cauline bracts, varying in number from two to four or occasionally more. These bracts soon wither, becoming brown and membranaceous.

INDUMENT. The amount and the nature of the pubescence are valuable as diagnostic characters in distinguishing species. Especially diagnostic is the nature of the cilia of the leaf-margins. On the basis of this character, the section can be split into two groups—those with the cilia regularly arranged and pointing sharply forward, and those with the cilia irregularly distributed and pointing in all directions. In the first group are *D. Hookeri* and *D. lanuginosum;* in the second are *D. maculatum*, *D. Smithii*, and *D. trachycarpum*. Hispidulous anthers identify *D. Hookeri* var. *trachyandrum*, and stellate-glandular hairs on the ovary are found only in *D. maculatum*.

INFLORESCENCE. In the section *Prosartes* the inflorescence is strictly terminal. The flowers are either solitary or, more often, in a few-flowered umbel, nodding on slender pedicels. The number of flowers per inflorescence is not constant within a species and is of no value in distinguishing the species.

PERIANTH. The perianth consists of six distinct segments in two similar series. The perianth-segments of *D. maculatum* are purple-spotted, making this species easily recognizable in flower. The color of the perianth-segments in the other species is ochroleucous or greenish white. The shape of the perianth-segments is fairly constant within a species and has some diagnostic value in distinguishing between certain species. For instance, the perianth-segments of *D. lanuginosum* are widest at, or usually below, the middle, while those of *D. Hookeri* are usually wider above the middle. The perianth-segments of *D. maculatum* are narrowed below into a claw. In all of the species the segments are more or less gibbous below.

STAMENS. The six stamens are adnate to the base of the perianth-segments, falling with them. The filaments are fili-

form or slightly dilated below the middle and are glabrous. The anthers are extrorse, innate, more or less sagittate, and laterally dehiscent. They are glabrous in all forms except *D. Hookeri* var. *trachyandrum*, where they are minutely hispid.

Pistil. The ovary is sessile, ellipsoidal to obconic, trilocular, with two to six ovules per locule. The style is filiform, glabrous or pubescent, included or exserted. The stigma is entire or slightly 3-cleft. The branching of the stigma must be used with caution as a diagnostic character because entire stigmas occasionally occur in species that usually have a 3-cleft stigma, and 3-cleft stigmas are occasionally found in species that commonly have an entire stigma.

Fruit. The fruit is a reddish or straw-colored berry. The berries of *D. maculatum* and *D. trachycarpum* are somewhat similar to each other and are strikingly dissimilar to the berries of the rest of the species. In *D. maculatum* and *D. trachycarpum* the berries are papillose, with stellate-glandular hairs arising from the papillae in *D. maculatum*, and the papillae glabrous in *D. trachycarpum*. The berries of the other species are smooth-skinned and essentially glabrous.

Cytology

Previous to the present study, little was known about the chromosome numbers in the section *Prosartes*. Lawson (1911) reported a chromosome number of $n = 5$ for *D. Hookeri* and Rattenbury (1948) reported $n = 9$ for the same species (*D. Hookeri* var. *Hookeri* of this treatment). Rattenbury's material was available to the writer and his report was confirmed.

Hasegawa (1932) reported chromosome counts for three species of the section *Eudisporum*. He found that *D. pullum* (= *D. cantoniense*), *D. sessile*, *D. smilacinum*, var. *ramosum* all had a chromosome number of $2n = 16$ and in one sterile triploid, *D. sessile*, $2n = 24$.

Cytological material for the present study was obtained, when practicable, from several localities within the range of each species. Root tips were fixed in Belling's modified Navashin's fluid (Johansen, 1940) and stained with crystal violet.

The following tabulation lists the chromosome number of six taxa, from fourteen localities, with the time and place that the

collection was made, and the herbarium that now has the collection from which chromosome counts were taken.

Species	n	2n	Source
D. Hookeri var. *Hookeri*	9	..	½ mi. E. of Oakland Tunnel, Contra Costa Co., Cal., Apr. 13, 1948, *J. A. Rattenbury 111* (UC).
D. Hookeri var. *Hookeri*	..	18	1 mi. N. of La Honda, San Mateo Co., Cal., Apr. 8, 1950, *G. H. Ward 949* (WS).
D. Hookeri var. *trachyandrum*	..	18	Waldo-Happy Camp Road, T. 41 S., R. 7 W., Sect. 8, Josephine Co., Ore. June 5, 1950, *Q. Jones 10* (WS).
D. Hookeri var. *oreganum*	..	18	Along N. Fork of Clearwater River, above Ahsahka, Clearwater Co., Ida., May 8, 1949, *M. Ownbey 3174* (WS).
D. Hookeri var. *oreganum*	..	18	10 mi. N. E. of Emida, Benewah Co., Ida., May 28, 1949, *M. Ownbey & Q. Jones 3191* (WS).
D. Hookeri var. *oreganum*	..	18	1 mi. E. of Harvard, Latah Co., Ida., May 28, 1949, *M. Ownbey & Q. Jones 3188* (WS).
D. Hookeri var. *oreganum*	..	18	½ mi. E. of Issaquah, King Co., Wash., June 3, 1949, *Q. Jones 3* (WS).
D. lanuginosum	..	18	Greer, Monongalia Co., W. Va., Oct., 1944, *H. A. Davis*. Grown at Pullman, Wash., May 9, 1949, *M. Ownbey* (WS).
D. lanuginosum	..	18	Calcareous bluffs below Norris Dam, Anderson Co., Tenn., May 2, 1950, *A. J. Sharp 13431* (WS).
D. Smithii	..	16	1 mi. E. of Steven's Cr., Grays Harbor Co., Wash., Apr. 4, 1949, *Q. Jones 1* (WS).
D. Smithii	..	16	5 mi. N. of Copalis Crossing, Grays Harbor Co., Wash., June 4, 1949, *Q. Jones 4* (WS).
D. trachycarpum	..	22	N. side of Kamiak Butte, Whitman Co., Wash., May 21, 1949, *Q. Jones 2* (WS).
D. trachycarpum	..	22	Puffers Butte, Asotin Co., Wash., June 19, 1949, *Q. Jones 8* (WS).
D. trachycarpum	..	22	7 mi. N. W. of Hulett, Crook Co., Wyo., July 28, 1949, *M. Ownbey 3212* (WS).

The chromosomes are similar in size and morphology in the different species and varieties. In each, one pair is distinguished by satellites. Chromosome number, however, varies between the species. *D. Smithii* has 8 pairs like the Asiatic species which it resembles more closely than do the other American species. *D. Hookeri* and its varieties have 9 pairs, as does *D. lanuginosum*. These 9-paired species are morphologically similar and may be

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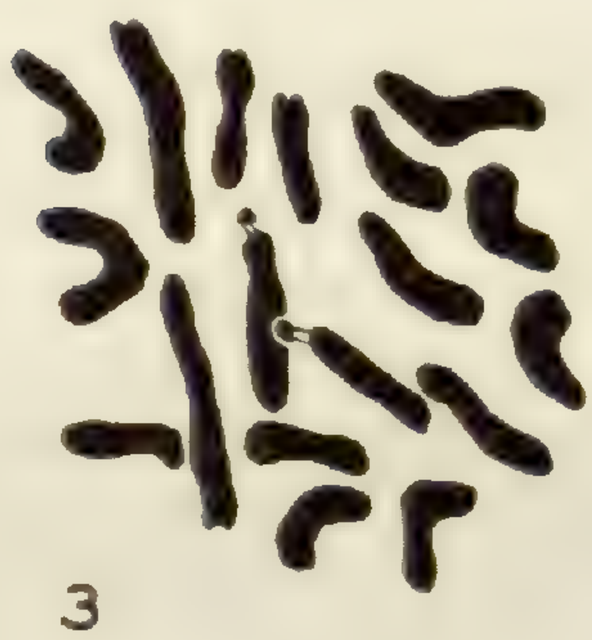

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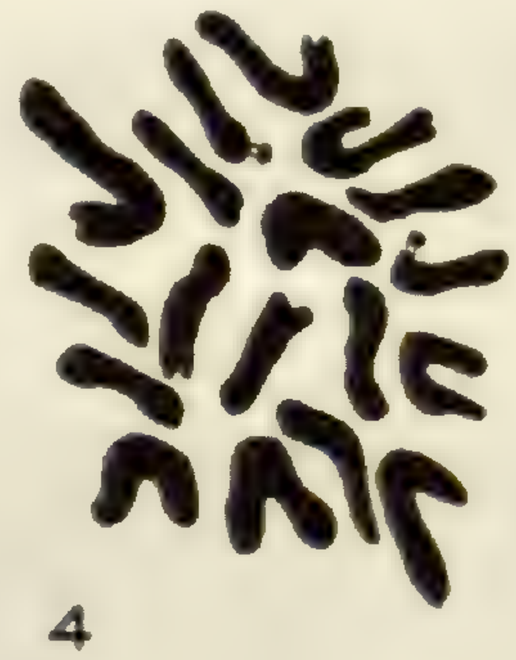

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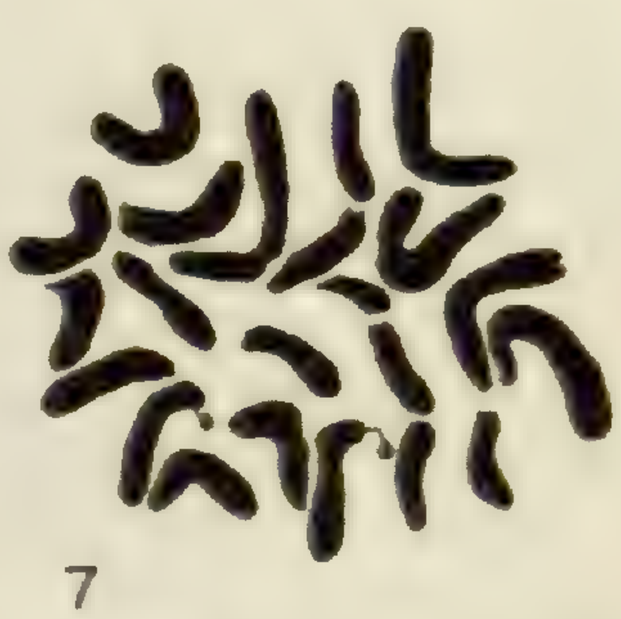


7

Figs. 1–7. Camera lucida drawings of metaphase plates in *Disporum*. Fig. 1. *Disporum Hookeri* var. *Hookeri*. Metaphase II, meiotic division of microsporocyte. Fig. 2. *Disporum Hookeri* var. *oreganum;* Fig. 3. *Disporum Hookeri* var. *trachyandrum;* Fig. 4. *Disporum Hookeri* var. *Hookeri;* Fig. 5. *Disporum lanuginosum;* Fig. 6. *Disporum Smithii;* Fig. 7. *Disporum trachycarpum;* all mitotic metaphase divisions from root tip cells. (All × 1900).

considered closely related. *D. trachycarpum* has 11 pairs of chromosomes, and, in its morphological characteristics also, is set apart from the other species. No cytological material of *D. maculatum* or of the suspected interspecific hybrid, *D. parvifolium*, was available for study.

Acknowledgments

The writer is indebted to Dr. Marion Ownbey for advice and assistance in the investigation and for helpful criticism of the writing, and to those persons who have supplied plant material that was otherwise unobtainable, especially Dr. E. Lucy Braun, Dr. A. J. Sharp and Mr. George H. Ward. The author also wishes to thank the curators of the herbaria[2] who made available on loan the large number of specimens studied.

Taxonomy

Disporum Salisbury ex D. Don

Disporum Salisbury in Trans. Hort. Soc. **1:** 331. 1812, *nomen nudum;* ex D. Don in Prod. Fl. Nep. 50. 1825; emend. Bentham & Hooker, Gen. Plant. **3:** 831. 1883.

Drapiezia Blume, Enum. Pl. Jav. **1:** 8. 1827.

Prosartes D. Don in Trans. Linn. Soc. [London] **18:** 531. 1841. Type-species: *Disporum cantoniense* (Loureiro) Merrill [*Disporum pullum* Salisbury].

Pubescent or glabrous herbs from a perennial rootstock. Stem erect, sparingly branched above, with one or more papery sheathing bracts below the first branch. Leaves alternate, sessile or subsessile, often clasping, linear to ovate, principal veins 3, the veinlets forming a loose reticulum. Inflorescence terminal, sometimes appearing lateral; flowers solitary or few in an umbel, nodding on slender pedicels. Perianth-segments 6, in two similar series, distinct, ochroleucous to greenish white or purplish, lance-linear to lance-ovate or oblanceolate, each with 3 principal veins, the few veinlets loosely reticulate. Stamens 6, hypogynous, adherent to the bases of the perianth-segments; filaments filiform or dilated below; anthers linear-oblong, somewhat sagittate, extrorse, dehiscing laterally. Ovary sessile, narrowly ellipsoidal to obovoid, 3-locular; ovules anatropous, 2 to 6 per locule, pendulous, horizontal or ascending from axile placentae; style filiform, stigma entire or more or less 3-branched. Fruit a straw-colored to reddish or dark blue to black berry; seeds globose, smooth, with stony endosperm.

[2] In citing material studied, the following abbreviations for the different herbaria are used: California Academy of Sciences Herbarium, CA; Clokey Herbarium, University of California, Berkeley, CLUC; Dudley Herbarium, Stanford University, D; Gray Herbarium, Harvard University, G; Missouri Botanical Garden Herbarium, M; New York Botanical Garden Herbarium, NY; State College of Oregon Herbarium, OS; Pomona College Herbarium, P; Rocky Mountain Herbarium, University of Wyoming, RM; University of California Herbarium, Berkeley, UC; University of Michigan Herbarium, UM; University of Oregon Herbarium, UO; United States National Herbarium, US; University of Washington Herbarium, UW; State College of Washington Herbarium, WS; Willamette University Herbarium, WU.

Section 1. Eudisporum, sect. nov.

Disporum Salisbury ex D. Don, Prod. Fl. Nep. 50. 1825. *Sensu stricto.* Type-species: *Disporum cantoniense* (Loureiro) Merrill [*Disporum pullum* Salisbury].

Plantae glabrae, folia saepius linearia vel lanceolato-linearia. Inflorescentia saepius pseudo-lateralis. Flores ochroleuci vel subpurpurei; tepala infra in calcare conspicuo producta; stigma plerumque profunde 3-partitum; ovula adscendentia. Baccae atrocaeruleae vel nigrae.

Glabrous plants with the leaves often lance-linear or linear. Inflorescence often appearing lateral because of continued growth of a branch from the second node below. Flowers ochroleucous or purplish; perianth-segments produced into a conspicuous spur below; stigma usually deeply 3-parted; ovules ascending. Berry dark blue to black. About 12 species in southeastern Asia and adjacent islands.

Section 2. Prosartes (D. Don), stat. nov.

Prosartes D. Don in Trans. Linn. Soc. [London] **18:** 531. 1841. Type-species: *Disporum lanuginosum* (Michaux) Nicholson [*Streptopus lanuginosus* Michaux].

Pubescent plants with lanceolate to ovate leaves. Inflorescence terminal. Flowers ochroleucous or greenish white; perianth-segments lance-linear to lance-ovate or oblanceolate, truncate and/or slightly gibbous below; stigma entire or slightly 3-cleft; ovules pendulous or horizontal. Berry reddish or straw-colored. Five species in North America.

Key to the Species of the Section Prosartes

A. Ovary broadly ovoid or obpyriform, papillose or covered with ascending, stellate-glandular hairs; ovules horizontal; leaf-margins with flattened hairs irregularly distributed, or glabrous.
  B. Perianth-segments with few to many purple spots; ovary papillose with ascending stellate-glandular hairs arising from the papillae; leaves acuminate. Eastern North America ..... 1. *D. maculatum.*
  BB. Perianth-segments lacking purple spots; ovary merely papillose; leaves acute. Western North America .. .. 2. *D. trachycarpum.*

AA. Ovary ellipsoidal, glabrous or with a pubescence of simple hairs; ovules pendulous.
  C. Flowers cylindrical, truncate or slightly gibbous below, or small with subsessile anthers and an abortive ovary; fruit, if formed, usually more than 6-seeded; leaf-margins sparsely ciliate or glabrous.
    D. Flowers large, mostly more than 1.5 cm. long, cylindrical, truncate below; ovary normal; stem usually more than 4 dm. tall; leaves usually more than 5 cm. long ..... 3. *D. Smithii.*
    DD. Flowers small, 10 mm. or less in length; anthers subsessile; ovary abortive; stem usually about 3 dm. tall; leaves usually less than 4 cm. long. S. W. Oregon and adjacent California ..... 4. *D. parvifolium.*

CC. Flowers turbinate, narrowing and slightly gibbous below; fruit never more than 6-seeded; leaf-margins with short, pointed hairs directed sharply forward.
E. Perianth-segments long-acuminate, widest at or below the middle (lance-linear); ovary usually glabrous, stigma usually 3-cleft; veins of the lower surface of the leaves densely lanulose. Eastern North America.....5. *D. lanuginosum.*
EE. Perianth-segments short-acuminate, widest at or above the middle (oblanceolate); ovary pubescent or glabrous, stigma rarely 3-cleft; lower surface of the leaves scabridulous or puberulent, the hairs more or less evenly distributed. Western North America.....6. *D. Hookeri.*

1. **Disporum maculatum** (Buckley) Britton.

Streptopus maculatus Buckley in Amer. Journ. Sci. Ser. II, **45:** 170. 1843.
Prosartes maculata A. Gray in Amer. Journ. Sci. Ser. II, **47:** 201. 1844.
Disporum maculatum Britton in Bull. Torrey Bot. Club **15:** 188. 1888. Based on an S. B. Buckley collection from "Cumberland Mountains, Tennessee." Probable type or isotype at Gray Herbarium studied.
Disporum Cahnae Farwell in Amer. Midl. Nat. **8:** 267. 1923. No type designated. Apparently based on *Mrs. Cahn and O. A. Farwell 5769 and 6141*, collected May 22, 1921, and May 7, 1922, at Farmington, Michigan. Probable isotype (*5769*) at the Gray Herbarium studied.
Disporum Schaffneri Moldenke in Phytologia **1:** 167. 1935. Based on *D. Demaree 10749*, collected June 21, 1934, at Camp Gordon C. C. C., Friendship, Scioto Co., Ohio. Type at Herbarium New York Botanical Garden studied.

Plant 3 to 8 dm. tall. Leaves ovate, acuminate, 3 to 10 (to 16) cm. long, moderately pubescent with flattened multicellular hairs on the veins of the lower surface and margins, otherwise glabrous or glabrate. Flowers solitary to 4 in a cluster, broadly campanulate, 15 to 25 mm. long; perianth creamy white, with few to many purple spots, the segments lance-ovate, narrowing into a claw. Stamens exserted, nearly equaling the style; filaments filiform, 4 times as long as the anthers. Ovary obpyriform, becoming obconic after anthesis, covered with ascending, stellate-glandular hairs; ovules horizontal, 2 to 4 per locule. Style filiform, glabrous; stigma 3-cleft. Berry pale straw-color, 10 mm. or more across, 3-lobed, the lobes subspherical, papillose, with stellate hairs arising from the papillae.

Disporum maculatum is a constant and easily recognizable entity. The purple spots on the perianth-segments and the broad, 3-lobed, hairy-papillose fruit distinguish it from all other species of the genus. The general shape and papillosity of the fruit, the orientation of the ovules, and the similarity of leaf pubescence, however, relate it more closely to *D. trachycarpum* than to any other species, and, did their ranges overlap, there

might be difficulty in distinguishing sterile plants. The leaves of *D. maculatum*, however, are consistently more acuminate (to long-acuminate), whereas those of *D. trachycarpum* are merely acute. Furthermore, usually no more than five veins become prominent in the leaves of *D. maculatum*, whereas in those of *D. trachycarpum*, there are commonly from seven to nine prominent veins.

Distribution. Rich woods, southern Appalachian Mountains, and in southern Ohio and southeastern Michigan (Map 1). ALABAMA. Jackson Co.: Sand Mt., near Carpenter, Apr. 15, 1914, *A. H. Howell 824* (US); Eliza, Apr., 1917, *E. W. Graves 1082* (M). GEORGIA. Mts. of Georgia, *Chapman* (NY). KENTUCKY. Harlan Co.: Pine Mt., May 23, 1928, *A. W. Christensen* (G). Letcher Co.: Collier's Cr., Black Mt., June 8, 1933, *E. L. Braun* (G), May 4, 1934, (G, NY); Little Joe Day Branch, Pine Mt., June 24, 1933, *Braun* (G). MICHIGAN. Oakland Co.: Farmington, May 22, 1921, *Mrs. Cahn and O. A. Farwell 5769* (G), May 7, 1922, *Cahn & Farwell* (NY, photograph). Washtenaw Co.: Ann Arbor, May 20, 1884, *G. B. Sudworth 43* (NY). NORTH CAROLINA. Buncombe Co.: Busbee Mt., Apr. 22, 1896, May 2, 1904, *Biltmore Herbarium 3196, 3196d* (US). Madison Co.: Hot Springs, Apr. 27, 1897, *Biltmore Herbarium 3196b* (G, NY, US), May 3, 1904, *3196c* (NY, RM), Apr., 1891, *J. S. Newberry* (NY, US), Apr. 23, 1896, *C. S. Newhall* (NY), Apr., 1888, *C. E. Smith* (G). OHIO. Adams Co.: Churn Cr., July 15, 1928, *A. R. Harper* (NY). Scioto Co.: Camp Gordon, Friendship, Shawnee State Forest, Apr. 4, 1934, *D. Demaree 10597* (NY, US), Apr. 30, 1935, *11279* (US), May 5, 1935, *11301* (CA, D, G, M, US). TENNESSEE. Cumberland Mts., North Carolina and Tennessee, *S. B. Buckley* (G, NY) (probable isotypes); above Warmsprings, Tenn., Apr., 1842, *Rugel* (NY). Cocke Co.: Wolf Cr., Apr. 15, 1898, *H. P. Allen* (US); Wolf Cr., May, 1898, *A. Ruth 138* (US), *145* (M, NY), June, 1900, (NY). Knox Co.: Knoxville, May, 1897, *Ruth* (NY), June 10, 1902 (P).

2. **Disporum trachycarpum** (S. Watson) Bentham & Hooker.

Prosartes trachycarpa S. Watson in U. S. Geol. Expl. 40th Par. **5:** 344. [Bot. King Exped.] 1871; *Disporum trachycarpum* Bentham & Hooker, Gen. Plant. **3:** 832. 1883. Based on *S. Watson 1166* (in part), collected June, 1869, at Parley's Park [Summit Co.], Utah. Type at Gray Herbarium studied.

Uvularia lanuginosa β major Hooker, Fl. Bor. Am. **2:** 174. 1840; *Disporum major* Britton in Bull. Torrey Bot. Club **15:** 188. 1888. Based on a Richardson collection from "between Norway House and Cumberland House Fort" [Manitoba & Saskatchewan]. Type not seen, but no other species is known from this area.

Disporum trachycarpum var. *subglabrum* Kelso in Rhodora **39:** 150. 1937. Based on *D. T. McDougal 64*, collected May 2, 1891, at Weit's Canyon

near Flagstaff [Coconino Co.], Arizona. Type in U. S. National Herbarium studied.

Plant 3 to 8 dm. tall. Leaves ovate, acute, usually somewhat oblique at base, 3 to 10 cm. long, lower surface and margins moderately pubescent with minute flattened hairs, becoming glabrate or glabrous with maturity, upper surface glabrous. Flowers solitary or two, creamy white, 10 to 15 mm. long; perianth narrowly campanulate, the segments oblong-linear, slightly gibbous below. Stamens equaling or slightly exceeding the perianth-segments in length, filaments filiform, 3 times as long as the anthers. Ovary broadly ovoid, becoming 3-lobed and obpyriform after anthesis, papillose; ovules horizontal, 2 to 6 per locule. Style filiform, glabrous or pubescent; stigma 3-cleft or occasionally entire. Berry orange to bright red, subglobose; seeds 6 to 18, commonly 6 to 12.

Disporum trachycarpum has often been confused with *D. Hookeri* var. *oreganum* but these taxa are entirely distinct. A 3-lobed stigma has been considered to characterize *D. trachycarpum*, whereas the stigma of *D. Hookeri* var. *oreganum* has been thought to be consistently entire. Both taxa are quite variable regarding this character. They are separated, however, by the following features.

D. TRACHYCARPUM

1. Lower surface and margins of the leaves with minute flattened hairs—those of the margins not pointing sharply forward—or glabrous; leaf-apices acute.
2. Ovary broadly ovoid to obpyriform, papillose.
3. Fruit usually more than 6-seeded, papillose.

D. HOOKERI VAR. OREGANUM

1. Leaf surfaces puberulent, the cilia of the margins pointing sharply forward; leaf-apices acuminate to long-acuminate.
2. Ovary narrowly ellipsoidal, lanulose or glabrous.
3. Fruit usually less than 6-seeded, essentially glabrous.

The amount of pubescence in *D. trachycarpum* is variable. Frequently, mature plants are entirely glabrous, but young plants are usually hairy. Glabrosity shows no significant correlation with geographical distribution, hence does not warrant taxonomic recognition. With the exception of this variable, the species is constant throughout its range.

DISTRIBUTION. In shady woods, Rocky Mountains from Arizona and New Mexico to northern British Columbia and Alberta, westward in the Blue and Ochoco mountains of Oregon and on the eastern slope of the Cascade Mountains of northern Washington and British Columbia, eastward to the Sand Hills of Nebraska, the Black Hills of South Dakota, and the Turtle Mountains of North Dakota (Map 3). ALBERTA. ACADIA DIST.: Rosedale Trail, May 13, July 31, Aug. 7, 1915, *Moodie 868* (CA, CLUC, D, G, M, NY, OS, RM, US). ATHABASKA DIST.: vicinity of Fort

McMurray, junction of Athabaska and Clearwater Rivers, Sept. 11, 1935, *Raup 7110* (G). CALGARY WEST DIST.: Banff and vicinity, Sulphur Mt., June 14, 1906, *S. Brown 153* (G, M, NY, US); Calgary, June 7, 1897, *Macoun* (NY). CAMROSE DIST.: Rochon Sands, Buffalo lake, Erskine, Aug. 22, 1926, *Brinkman 2596* (US). JASPER-EDSON DIST.: Cabin Cr., Jasper, Jasper National Park, Aug. 3–16, 1943, *E. Scamman 3024* (G, US). MCCLEOD DIST.: 5 mi. w. of Pincher Cr., July 29, 1939, *E. H. Moss 142* (G, US), May 19, 1941, *1196* (G). RED DEER DIST.: North Fork, North Branch Saskatchewan, base of Mt. Wilson, June 20, 1908, *Brown 993* (G, NY). VEGREVILLE DIST.: Fort Saskatchewan, Aug. 18, 1935, May 23, 1936, *G. H. Turner 70* (G, NY), May 14, 1939, *1192* (G). WETASKIWIN DIST.: Edmonton, May 18, 1937, *Moss 4191* (WS). BRITISH COLUMBIA. CARIBOO DIST.: 5 mi. N. of Prince George on Summit Lake, May 19, 1939, *T. T. McCabe 6954* (UC). EAST KOOTENAY DIST.: Elk River Road, 16 mi. N. of Natal, Sept. 8, 1937, *McCabe 4929* (UC). KAMLOOPS DIST.: Clearwater River Road, 13.2 mi. from North Thompson River Road, (Camp Cr.), May 11, 1934, *McCabe 1059* (UC). SKEENA DIST.: New Hazelton, May 23, 1939, *McCabe 7004* (UC, UW), Aug. 10, 1940, *8246* (UC). YALE DIST.: Fairview Pass between Oliver and Keremeos, May 6, 1938, *McCabe 5913* (UC). MANITOBA. BRANDON DIST.: Oak River at Lothair, June 21, 1906, *J. Macoun 78375* (G). MARQUETTE DIST.: Clear Lake, Riding Mt. National Park, Aug. 29–Sept. 2, 1941, *E. Scamman 2862* (G). SASKATCHEWAN. Without locality, 1857–58, *E. Bourgeau* (G, NY). PRINCE ALBERT DIST.: Prince Albert, June 29, 1896, *J. Macoun 13832* (NY). QU'APPELLE DIST.: Indian Head, June, 1892, *W. Spreadbrogh* (NY). ARIZONA. APACHE CO.: Luka Chukai Mts., June 30, 1936, *G. J. Goodman & L. B. Payson 2837* (G, M, NY, UW), Aug. 9, 1939, *3192* (CLUC, G, M, NY, UW). COCONINO CO.: Bill Williams Mt., June 9, 1883, *H. H. Rusby 843* (NY, UM, US). PIMA CO.: Near Soldiers Camp, Santa Catalina Mts., Aug. 1, 1916, *J. A. Harris 16436* (US). COLORADO. BOULDER CO.: Boulder Cr., May 28, 1921, *C. B. & I. W. Clokey 4062* (CLUC). FREMONT CO.: Base of the Sierra Sangre de Cristo, Aug. 1874, *T. S. Brandegee 935* (UC). GILPIN CO.: Eldora to Baltimore, June 20–July 10, 1903, *F. Tweedy 5513* (NY, RM). LA PLATA CO.: La Plata Canyon, near Pamoer City, Sept., 1875, *Brandegee* (UC). LARIMER CO.: Fern River, Mts., Estes Park, Aug. 15, 1895, *G. E. Osterhout 839* (RM). MINERAL CO.: Near Pagosa Peak, Aug., 1899, *C. F. Baker 253* (G, M, NY, P, RM, US). OURAY CO.: Mts. about Ouray, June 22, 1892, *Crandall* (NY). SAN MIGUEL CO.: Telluride, Aug. 11, 1896, *Biltmore Herbarium 2159a* (US); Iron Springs, Mesa, June 12, 1912, *E. B. Payson 50* (RM). IDAHO. ADAMS CO.: Seven Devils Mts., Aug. 5, 1899, *M. E. Jones* (P). BANNOCK CO.: City Cr., May, 1934, *R. J. Davis* (RM); Pocatello, summer 1926, *R. Donaghe 41* (CA); Caribou Forest, Blackfoot Canyon, below Trail Ranger Station, Sept. 2–11, 1913, *W. W. Eggleston 9996* (US); Bannock Range, May 21, 1939, *R. R. Wilson 352* (D). BONNER CO.: Trestle Cr., T. 57 N., R. 1 E., July 27, 1941, *Davis 3911* (CA); Lake Pend Oreille, June 1891, *J. B. Leiberg 64* (UC); between Priest Lake and East

Fork, July 27, 1900, *D. T. MacDougal 222* (NY, RM). BOUNDARY CO.: Near Copeland, Aug. 23, 1922, *J. H. Ehlers & C. O. Erlanson 236* (UM). CLARK CO.: Little Dry Cr. Canyon, Spencer, June 16, 1916, *H. J. Rust 56* (CA). ELMORE CO.: Spring Mt., Atlanta, Boise National Forest, July 5, 1941, *F. A. McFadden 15767* (CA). IDAHO CO.: below Cow Camp, at head of Squaw Cr., May 15, 1937, *G. Munro 79* (WS); along Granite Cr., Snake Canyon, Apr. 5, 1938, *J. Packard 373* (UC, WS). KOOTENAI CO.: Coeur d'Alene, May 10, 1909, *S. O. Johnson 61* (RM); Lakeview, Aug. 15, 1892, *MacDougal 1038* (P, US); Spirit Lake, May, 1931, *M. Milburge* (UW). LATAH CO.: Summit of Moscow Mts., Sec. 13, T. 40 N., R. 5 W., July 17, 1949, *M. Ownbey 3208* (WS). LEMHI CO.: Bohannan Cr., above the mines, near Salmon, Aug. 28, 1895, *Henderson 3950* (US); Long Tom Camp, May 15, 1941, *G. Williams* (CLUC). NEZ PERCE CO.: Craig Mts., near Lake Waha, May 20, 1892, *Sandberg, MacDougal, Heller 198, 1038* (D, G, NY, P, US), June, 1892, *Sandberg* (D, M). WASHINGTON CO.: Starkey Hot Springs, Aug. 7, 1911, *J. A. Clark 202* (G, M, NY, RM, UC, US); Middle Fork, Weiser River, Aug. 3, 1899, *Jones* (P). MONTANA. BEAVERHEAD CO.: Red Rock Lake, June 30, 1899, *A. & E. Nelson 5473* (G, M, NY, RM, US). CASCADE CO.: Little Belt Mts., 9 mi. from Barker, Aug. 17, 1896, *J. H. Flodman 354* (NY, US). FLATHEAD CO.: Yellow Bay, Aug. 7, 1908, *Butler 953* (NY); Swan Lake, Aug. 25, 1908, *Clemens* (D); Somers, July 17, 1908, *M. E. Jones 9184* (P); Big Fork, Aug. 6, 1908, *Jones 9185* (P, US), July 20, 1908, *9186* (P, US), July 24, 1908, *9187* (P, M), Aug. 5, 1909 (P); vicinity of Glacier Hotel at the head of Lake McDonald, Aug. 22, 1919, *P. C. Standley 17858* (US). GALLATIN CO.: 5 mi. N. E. of Bozeman, May 26, 1947, *W. E. Booth 1531* (UW, WS). GLACIER CO.: Waterton Lake, Aug. 17, 1910, *M. E. Jones* (P); along Swiftcurrent Cr., below Lake McDermott, July 17, 1919, *Standley 15937* (US); Aug. 5, 1919, *16984* (US); vicinity of Going-to-the-Sun Chalets, on St. Mary Lake, Aug. 6–7, 1919, *Standley 17060* (US); vicinity of Glacier Park Station, Aug. 18, 1919, *Standley 17827* (US). LAKE CO.: Mission Canyon, Apr. 29, 1938, *F. A. Barkley 2689* (WS); near Biological Station, Flathead, May 15, 1938, *D. Smith & S. Warg 41* (G, M, NY). LEWIS & CLARK CO.: Helena, May, 1893, *E. Starz* (M). MINERAL CO.: Fish Cr., Superior, May 26, 1944, *M. Lamm 17040* (RM). MISSOULA CO.: 15 mi. N. W. of Missoula, May 5, 1940, *M. Burdick 1* (WS); N. slope of Mt. Sentinel, Apr. 20, 1938, *E. W. Burett 4* (UW). PARK CO.: Electric Peak, Aug. 18, 1897, *P. A. Rydberg & E. A. Bessey 3882* (G, NY, RM); Livingston, May 10, 1901, *E. W. Scheuber* (NY), May 20, 1901, *Scheuber* (US); Mahn Cr., 9 mi. N. W. of Wilsall, Aug. 28, 1916, *W. N. Suksdorf 151* (G, WS). NEBRASKA. SIOUX CO.: War Bonnet Canyon, June 23, 1890, *T. A. Williams 76* (NY). NEW MEXICO. CATRON CO.: 10 mi. E. of Mogollon Mts., July 15, 1928, *C. B. Wolf 2706* (CA, D, G). LINCOLN CO.: Carrizo Mts., May–June, 1892, *W. Matthews* (US). RIO ARRIBA CO.: vicinity of Chama, July 10, 1911, *P. C. Standley 6764* (US); vicinity of Brazos Canyon, Aug. 20, 1914, *Standley & H. C. Bollman 10642* (US). SAN JUAN CO.: Navajo Indian Reservation, in the Tunicha Mts., Aug. 8,

1911, *Standley 7722* (US). NORTH DAKOTA. Bottineau Co.: shore of Lake Metigoshe, Turtle Mts., Aug. 1, 1942, *O. A. Stevens* (CLUC). Rollette Co.: in the foothills of the Turtle Mts., near Dunseith, Aug. 18, 1907, *J. Lunell* (NY). OREGON. Crook Co.: Between Mitchel and Prineville, vicinity of summit, Strawberry Range, Blue Mts., July 22, 1926, *H. L. Mason 3564* (UC); near Ochoco R. S., June 27, 1932, *M. E. Peck 17146* (WU). Grant Co.: Canyon Cr., Blue Mts., Apr. 24, 1925, *L. F. Henderson 5119* (CA, D, G, M, UO). Harney Co.: Near Burns, Harney Valley, Sept. 28, 1896, *H. E. Brown 95* (M, NY); Sawtooth Cr. bottoms, June 18, 1927, *Henderson 8833* (CA, UO); upper Emigrant Cr., Aug. 4, 1912, *Peck 1412* (WU). Union Co.: Banks of Catherine Cr., near Union, June 16, 1928, *J. W. Thompson 4851a* (UW). Wallowa Co.: 1 mi. S. of Wallowa Lake, July 18, 1936, *L. S. Rose 36474* (CA); near head of Griffith's Cr., July 28, 1897, *E. P. Sheldon 8656* (G, M, NY, UC). SOUTH DAKOTA. Custer Co.: Elk Mts., July 12, 1906, *M. Cary 54* (US); Sylvan Lake, June 8, Aug. 17, 1892, *P. A. Rydberg 1049* (G, NY, US). Harding Co.: Cave Hills, July 29, 1920, *W. H. Over* (US). Lawrence Co.: Whitewood, June 1, 1921, *R. H. Brigham 13733* (US); Deadwood, July 19, 1913, *W. P. Carr 85* (G, M, NY, RM, US); Spearfish Canyon, Black Hills, Aug. 11, 1941, *G. J. Goodman 3336* (CLUC, G, M, NY, UW), Aug. 1, 1926, *H. E. Hayward 103* (NY), June 25, 1927, *1456* (WS); Terry Peak above Trojan, July 4, 1927, *Hayward 1873* (RM); Crook Mt. Ranger Station, May 27, 1909, *J. Murdoch Jr. 3519* (D, G). Meade Co.: Black Hills, near Fort Meade, 1887, *W. H. Forwood 352* (US); base of limestone cliff, Tilford, Elk Cr., Piedmont, May 16, 1924, *A. C. McIntosh 49* (RM). Pennington Co.: Rockerville, Black Hills, June 16, 1909, *O. E. White* (M). UTAH. Cache Co.: Logan Canyon, E. slope, May 18, 1932, *B. Maguire 3268* (G, RM, UC); Providence Canyon, May 15, 1932, *Maguire 3270* (M). Iron Co.: Deer Cr. Canyon, May 8, 1938, *B. F. Harrison 8309* (UC). Salt Lake Co.: City Cr. Canyon, May 16, 1908, *J. Clemens* (D, G, M); Red Butte Canyon, May 8, 1909, *Clemens* (G); N. of Fort Douglas, July 17, 1880, *Jones* (NY, P, RM, UM, US, UW, WS). Sanpete Co.: Big Springs, near Fountain Green, Aug. 2, 1927, *J. A. Harris 27469* (P). Sevier Co.: Canyon S. of Glenwood, June 12, 1875, *L. F. Ward 203* (M, US). Utah Co.: N. Fork of Provo Canyon, May 27, 1933, *Harrison 7003* (RM); American Fork Canyon, July 8, 1895, *Jones* (P); Timpanogas Canyon, July 26, 1930, *E. J. Palmer 38096* (G). Weber Co.: Mountains near Ogden, 1871, *Hayden* (US). WASHINGTON. Asotin Co.: Puffer's Butte, June 19, 1949, *Q. Jones 8* (WS). Chelan Co.: Wenatchee, May 7, 18, 1896, *K. Whited 69* (US). Columbia Co.: Sec. 30, T. 9 N., R. 41 E., June, 1913, *H. T. Darlington* (WS); Blue Mts., May 1, Aug. 7, 1897, *R. M. Horner* (G). Okanogan Co.: Ptarmigan Cr., Hidden Lakes, May 31, 1936, *O. T. Edwards 256* (WS); along W. fork of Salmon Cr., S. W. of Conconully, June 12, 1932, *Fiker 849* (US, UW); near Rock Lake, May 12, 1933, *Fiker 1171* (UW, WS); Bonaparte Lake, July 8, 1921, *C. S. Parker 5281* (G, M, UC, UW, WS); along Twisp River, July 19, 1896, *Whited* (WS). Pend Oreille Co.: Newport, overlooking slough in Pond Oreille

River, May 5, 1923, *R. Sprague 145* (WS); Sacheen Lake, May 9, 1923, *Sprague 180* (WS). SPOKANE Co.: Clark Springs, July 10, 1902, *F. O. Kreager 130* (US, WS); Davis Ranch, July 25, 1902, *Kreager 310* (WS); E. of Colbert, July 12, 1923, *C. F. Lackey* (WS); Spokane, May 16, 1896, *C. V. Piper 2285* (G, NY, US, WS); Colbert, July 12, 1923, *Sprague 139* (WS); Hangman Cr., near Marshall, July 26, 1889, *Suksdorf* (WS); Latah Cr., May 12, 1916, *Suksdorf 8626* (UW, WS); Waikiki, May 28, 1913, *G. W. Turesson* (RM). STEVENS Co.: 9 mi. N. E. of Colville, May 22, 1923, *Sprague 202* (WS); 4 mi. S. of Alladin, May 22, 1923, *Speigelberg 91* (WS); east side of the Columbia River, at Kettle Falls, June 11, 1940, *H. T. Rogers 715* (WS); Columbia River Valley, 6 mi. N. E. of Northport, July 7, 1932, *G. G. Hedgcock* (UW). WHITMAN Co.: north side of Kamiak Butte, May, 1949, *Q. Jones 2* (WS). WYOMING. ALBANY Co.: near Tie City, June 1, 1901, *E. Madison 24* (RM); Laramie Hills, 1894, *A. Nelson 00* (G), June 13, 1896, *1933*, June, 1907, *9126* (RM). BIG HORN Co.: May, 1906, *I. T. Worthley 21* & *22* (RM, US). CROOK Co.: Bear Lodge Mts., June 20, 1912, *M. Cary 755* (US); Inyankara Mt., Aug. 21, 1897, *D. Griffiths* (US); Sundance Cr., July 2, 1896, *Nelson 2135* (RM); 7 mi. N. W. of Hulett, May 25, 1935, *M. Ownbey 581* (G, M, NY, RM, UC, WS). LINCOLN Co.: E. of Afton, June 25, 1923, *E. B. Payson & G. M. Armstrong 3266* (G, M, RM); Hoback River Camp, June 25, 1940, *L. E. Wehmeyer, F. N. Martin, & H. F. Loveland 5154a* (M, NY). NATRONA Co.: Casper Mt., July 26, 1894, *Nelson 609* (G, M, NY, RM, US). PARK Co.: Little Rocky, Clark's Fork Valley, June 22, 1924, *D. & E. Pearson 37, 38* (RM); Holm Lodge, about 40 mi. W. of Cody, Aug. 29, 31, 1922, *H. von Schrenk* (M). SHERIDAN Co.: above Big Horn, June 25, 1897, *L. H. Pammel & E. M. Stanton 361* (M); Willits Spring, May 25, July 30, 1909, *V. Willits 35* (RM). TETON Co.: Gros Ventres Pass, June 19, 1860, *F. V. Hayden* (M); 20 mi. S. of Jackson, July 19, 1901, *E. D. Merrill & E. N. Wilcox 956* (G, RM, US); Sheep Cr., June 13, 1933, *O. J. Murie 1004* (M); STS Ranch, Snake River bottom, July 27, 1932, *L. Williams 1058* (CA, G, M, NY, RM). WASHAKIE Co.: Squaw Cr., Tensleep Cr. Canyon, June 29, 1936, *L. O. & R. Williams 3159* (G, M, NY, RM, UW, WS). WESTON Co.: Stockade Beaver, July 22, 1910, *Nelson 9488* (G, RM). YELLOWSTONE PARK: near Mammoth Hot Springs, May, 1893, *F. H. Burglehaus* (M, NY, UC, UM, US, UW), July, 1893 (US, UW), Aug. 31, 1894 (UM); Druid Peak, July 12, 1899, *A. & E. Nelson 5790* (RM); near the N. E. corner of the Timber Reserve, Sept. 4, 1893, *J. N. Rose 565* (US).

3. **Disporum Smithii** (Hooker) Piper.

Uvularia Smithii Hooker, Fl. Bor. Am. **2:** 174, pl. 189. 1839; *Disporum Smithii* Piper in Contrib. U. S. Nat. Herb. **11:** 201. 1906. Based on two collections by Menzies and Scouler, from Nutka Sound [Nootka Sound, Vancouver Island, British Columbia]. Type not seen.

Prosartes Menziesii D. Don in Trans. Linn. Soc. [London] **18:** 533. 1841; *Disporum Menziesii* Britton in Bull, Torrey Bot. Club **15:** 188. 1888.

Based on a collection by Menzies from the northwest coast. Type in Smithian Herbarium not seen.

Plant 3 to 10 dm. tall. Leaves variable, lanceolate to ovate, acute to acuminate, usually somewhat oblique at base, 3 to 15 cm. long, lower surface and margins sparsely pubescent with long, twisted hairs or the entire leaf glabrous. Flowers 2 to 6 in a cluster, rarely solitary, creamy white, 1–3 cm. long; perianth cylindrical, truncate below, the segments oblong-linear, slightly gibbous at base. Stamens included, equaling or slightly shorter than the style; filaments filiform or slightly dilated near the base, about twice as long as the cylindrical anthers. Ovary triangular in cross section, elliptical in longitudinal section, glabrous or pubescent, ovules pendulous, 2 to 4 per locule. Style filiform, pubescent its full length; stigma 3-cleft. Berry dark red, broadly ellipsoidal, beaked with the style base; seeds commonly 5 to 9.

Disporum Smithii should not be confused with any other species of the genus. The chromosome number and flower shape suggest affinity with *D. sessile*, an Asiatic species, but it differs from that species in its pendulous ovules, reddish fruit, and somewhat pubescent herbage. *D. sessile* has ascending ovules, bluish fruit, and is glabrous throughout.

Distribution. In moist, shady places near the Pacific Coast from Vancouver Island south to Santa Clara Co., California (Map 4). BRITISH COLUMBIA. Nanaimo Dist.: Cowichan Lake, Vancouver Is., May 25, 1906, *J. R. Anderson* (WS); Nitinat River, June 2, 1916, *W. R. Carter 141* (G); Gordon River valley, Aug. 1, 1902, *C. O. Rosendahl 837* (D, M, NY, RM). CALIFORNIA. Del Norte Co.: along Smith River, near Crescent City, June 19, 1926, *E. I. Applegate 4730* (D); Gasquet Flat, Apr. 10, 1934, *L. M. Brown 23* (G); across the highway from Adams Station, May 23, 1937, *R. C. Foster 289* (G); Horse Mt., Apr. 29, 1928, *D. K. Kildale 5982* (D); 4 mi. E. (upriver) on Terivale road, July 24, 1921, *E. A. McGregor* (D); 1 mi. S. of Fort Dick, Sept., 1937, *Parks & Parks 24077* (D, G, NY, UC); Lee's Camp, Wilson Cr., Aug. 23, 1927, *C. B. Wolf 824* (D). Humboldt Co.: Big Lagoon, Sept. 1, 1927, *L. R. Abrams 12061* (D); Richardson Grove, *E. Armstrong 1169b* (UC); Port Trinidad, 1930, *R. K. Beattie 914-7* (G); 3 mi. E. of Orick, May 17, 1936, *Mrs. H. C. Cantelow* (CA); Dyerville, S. Fork of Eel River, May 12, 1933, *V. Duran 3413* (D, G, M, NY, P, RM, UC, US, UW, WS); Redwood Forests, S. of Eureka, July 14, 1931, *Jones 29227* (M, P, UC); near Hupa, Apr., 1901, *M. H. Manning 12* (UC); Arcata City Park, S. 28, T. 6 N., R. 1 E., May 17, 1933, *R. Stahelin* (VTM); Kneeland Prairie, June 9, 1908, *J. P. Tracy 2662* (UC); valley of Van Duzen River, opposite Buck Mt., June 27–July 30, 1908, *Tracy 2867* (UC); McClellan Mt., May 21, 1933, *Tracy 12209* (G, UC); between Garberville and Pepperwood, June 25, 1941, *Y. W. Winblad* (CA). Marin Co.: Redwood Canyon, Apr. 24, 1904, *M. S. Baker* (P, UC); Lagunitas Cr., July 14, 1893, *W. C. Blasdale* (RM); Olema,

Apr. 14, 1895, *Blasdale* (D); Bear Valley, Mar. 31, 1894, *J. B. Davy 703* (NY); Tocaloma, Apr. 4, 1917, *H. L. Mason 76* (D); near Camp Taylor, May 8, 1886, *Rattan* (D); Mt. Tamalpais, near Stinson Beach, Apr. 9, 1939, *L. S. Rose 39057* (CLUC, M, NY, US, UW). MENDOCINO Co.: Long Valley, 1860–67, *H. N. Bolander 4686, 4724* (G, UC, US); Big River, 1866, *Bolander 4818* (G, UC, US); Sherwood Valley, June 17, 1899, *W. R. Dudley* (D); Ten Mile River, June 24, 1894, *Eastwood* (G); Noyo, Aug. 8–16, 1912, *Eastwood 1626* (CA, CLUC, G, M, NY, US); bluffs beyond Fort Bragg, May 25, 1933, *L. F. Henderson 15434* (UO); Mendocino, July 10, 1931, *Jones 29226* (D, P); Cahto, June, 1869, *A. Kellogg & W. G. W. Harford 992* (G, NY, US); 3 mi. N. of Rockport on road to Redwood Highway, June 30, 1934, *Wolf 5828* (G). SAN FRANCISCO Co.: San Francisco, 1865, *Bolander* (M). SAN MATEO Co.: by road beyond La Honda Summit, Apr. 17, 1896, *Dudley* (M, P); Butano Cr., May, 1903, *A. D. E. Elmer 4697* (CA, D, M, NY, OS, P, UC, UO, US, WS); King's Mt., May, 1907, *E. A. McGregor* (M); Pilarcitos Cr., Apr. 21, 1895, *Davy 1057* (UC); in bottom of Purisima Canyon, below King's Mt., Mar. 9, 1906, *Dudley* (D, UW); along the Skyline Boulevard, just N. of road to La Honda, Apr. 30, 1937, *R. C. Foster 248* (G). SANTA CLARA Co.: June, 1877, *J. H. Edwards* (NY). SONOMA Co.: Stewart's Point, July 20, 1925, *M. Parks* (CA). OREGON. BENTON Co.: near Corvallis, May 20, 1923, *W. M. Atwood, W. E. Lawrence, H. S. Gilbert* (D); near Philomath, Apr. 25, 1938, *W. B. Cooke 10644* (OS); CLATSOP Co.: Saddle Mt., June 11, 1936, *J. Ifft & S. G. Wildman 29* (D, OS); Astoria, June 9, 1933, *G. E. Morrill 4* (UW). COLUMBIA Co.: near summit of Nehalem Range, upper Clatskanie Valley, May 15, 1927, *J. W. Thompson 2444* (UW); St. Helens, May, 1887, *T. Howell* (OS). Coos Co.: Iron Mt. E. slope, Apr. 26, 1947, *W. H. Baker 3724* (OS); Isthmus Slough, S. 23, T. 26 S., R. 13 W., Apr. 21, 1940, *L. E. Detling 4097* (UC, UO, UW, WS); Marshfield, Cape Arago, July 16, 1911, *W. Haydon 90* (CA); Myrtle Point, Apr. 20, 1893, *G. A. Holzinger 34* (US); near Charlston, June 16, 1926, *H. A. Scullen* (UC); between Bandon and Coquille, Apr. 14, 1927, *Thompson 2326* (UW). CURRY Co.: 9 mi. S. of Gold Beach, May 16, 1924, *L. R. Abrams & G. T. Benson 10675* (D, RM); between Agness and Lake of the Woods, Rogue River Mts., May 12, 1932, *E. I. Applegate 7173* (D); near Brookings, Mar. 14, 1926, *L. F. Henderson 7209* (UO); Winchuck River, Waterman's, May 7, 1929, *Henderson 10136* (UO); near mouth of Chetco River, Aug. 1, 1913, *M. E. Peck 3475* (WU); 3 mi. S. of Port Orford, July 1, 1919, *Peck 8615* (WU). DOUGLAS Co.: Umpqua River, T. 25 S., R. 7 W., Apr. 5, 1940, *Detling 3931* (UO); Cow Cr. Canyon, May 9, 1922, *M. W. Gorman 5628* (WS); bank of W. Fork at Hotel, Apr. 18, 1930, *Henderson 12547* (UO); near Roseburg, May, 1887, *T. Howell 574* (UC, WS); Elkton, Apr. 9, 1903, *E. P. Sheldon 11801* (UO). JOSEPHINE Co.: E. Illinois River, 3 mi. above Takilma, Apr. 26, 1926, *Henderson 5991* (CA, D, M, RM, UO). LANE Co.: vicinity of Noti, Apr. 20, 1924, *L. Constance* (UC); above Ranger Station, Winberry Cr., Apr. 20, 1933, *Henderson 15166* (UO); McLeod Cr., above Minerva, S. 24, T. 17 S., R. 11 W., Apr. 23, 1938, *Detling 2531* (UO); Canary, Apr. 24, 1938,

Detling 2543 (UO); Springfield, May 2, 1938, *Detling 2590* (UO, WS); Marten Ridge, Apr. 22, 1939, *Detling 3544* (UO); mouth of Cummins Cr., Apr. 14, 1934, *A. Eastwood & J. T. Howell 1502* (CA); bluffs along race from Old Power Plant, Mar. 20, 1934, *Henderson 16046* (UO); Big Fall Cr., May 14, July 11, 1938, *Henderson 18471* (UO). LINCOLN CO.: Newport, Aug. 25, 1929, *R. S. Ferris 7775* (D, P); Devil's Lake, Apr. 13, 1926, *Gorman 7557* (UO); upper Siletz River, Aug. 4, 1928, *Henderson* (UO); Alsea Mts., Apr. 29, 1939, *T. Lammi* (OS); Black Canyon, Walport, Apr. 14, 1928, *D. Overlander* (OS); Alsea Bay, Apr. 17, 1905, *A. R. Sweetser* (UO). LINN CO.: Cascadia, S. Santiam River, June 12, 1931, *Henderson 13707* (UO). MARION CO.: Silver Cr. Falls, June 8, 1916, *J. C. Nelson 667* (WS); auto camp grounds, Silverton, Apr. 15, 1928, *Thompson 4099* (D, M); Santiam River, near Mehama, May 9, 1928 *Thompson 4171* (D, M). MULTNOMAH CO.: Balch Cr., Portland, May 3, 6, 1907, *W. N. Suksdorf 1222* (CA, D, G, M, NY, UC, UW, WS). POLK CO.: Falls City, Apr. 17, 1915, *Nelson 61* (D); summit of the Coast Range, 10 mi. S. W. of Falls City, May 18, 1918, *Nelson 2147* (G). TILLAMOOK CO.: summit, Coast Range, road to Tillamook, June, 1886, *Gorman* (UW); on the line between Yamhill and Tillamook Cos., June 27, 1893, *W. J. Spillman 194* (WS); south of Tillamook, May 1, 1926, *Thompson 701* (D, M, UW). WASHINGTON CO.: Patton's Valley, May 20, 1896, *Lloyd* (NY). YAMHILL CO.: Coast Mts., July 9, 1882, *Henderson* (UM). WASHINGTON. CLALLAM CO.: 10 mi. E. of Sappho, May 29, 1938, *C. L. Hitchcock & J. S. Martin 3542* (CA, D, RM, UW, WS); 12 mi. W. of Lake Crescent, June 23, 1940, *I. L. Wiggins 9442* (D, G, NY, RM). COWLITZ CO.: 5 mi. W. of Kelso, Apr. 24, 1938, *Hitchcock 3279* (CA, D, RM, UW, WS). GRAYS HARBOR CO.: Humptulips, May 16, 1929, *W. T. Edwards* (UW); Whites, May 15, 1924, *Mrs. D. C. Frederick* (WS); near Montesano, June 7, 1898, *A. A. & E. G. Heller 3895* (M, NY, US); Humptulips River, Apr. 18, 1934, *G. N. Jones 4575* (UW); in alder thicket, 1 mi. E. of Stevens's Cr., T. 17 N., R. 7 W., Apr. 15, 1949, *Q. Jones 1* (WS); 5 mi. N. of Copalis Crossing, T. 19 N., R. 11 W., June 4, 1949, *Q. Jones 4* (WS); 2 mi. up Mt. Baldy Trail above Quinault Lake, June 5, 1949, *Q. Jones 6* (WS); Hoquiam, Apr. 19, 1897, *F. H. Lamb 1039a* (M, NY, WS). JEFFERSON CO.: Hoh River bottoms, June 3, 1924, *I. C. Otis 1280* (WS). LEWIS CO.: near Toledo, May 12, 1940, *F. W. Gould 1178* (UC). MASON CO.: Kamilche to Elma, May 19, 1929, *L. Benson 1425* (D, P, UW); Skokomish River, May 13, 1892, *T. Kincaid* (WS). PACIFIC CO.: North Head, Aug. 24, 1918, *O. Miner* (O, RM); Ilwaco, Aug. 14, 1924, *C. H. Spiegelberg 674* (WS). PIERCE CO.: Upper Nisqually valley, June 25, 1893, *C. D. Allen 117* (G); Mt. Rainier Nat. Park, Aug. 1, 1926, *H. L. Mason 3625* (UC). WAHKIAKUM CO.: Elokomin River, June 23, 1927, *H. St. John 8671* (WS); Altoona, July 20, 1909, *W. N. Suksdorf 6670* (WS).

4. **Disporum parvifolium** (Watson) Britton.

Prosartes parvifolia Watson, Bot. Cal. **2:** 179. 1880; *Disporum parvifolium* Britton in Bull. Torrey Bot. Club **15:** 188. 1888. Based on a

collection by V. Rattan, in the Siskiyou Mountains, in June, 1879. Type in the Gray Herbarium and isotype in the Dudley Herbarium studied.

Plant 1.5 to 4 dm. tall, shrubby in appearance. Leaves ovate, acuminate to acute, 1 to 5 cm., mostly 2 to 3 cm. long, glabrate or the margins and lower surface with a few scattered, twisted hairs. Flowers in twos and threes, creamy white, 5 to 10 mm. long; perianth narrowly campanulate, the segments oblong-lanceolate, acute. Stamens included; anthers subsessile, acute, about ½ as long as the perianth-segments. Ovary abortive. Style glabrous; stigma entire. Fruit unknown.

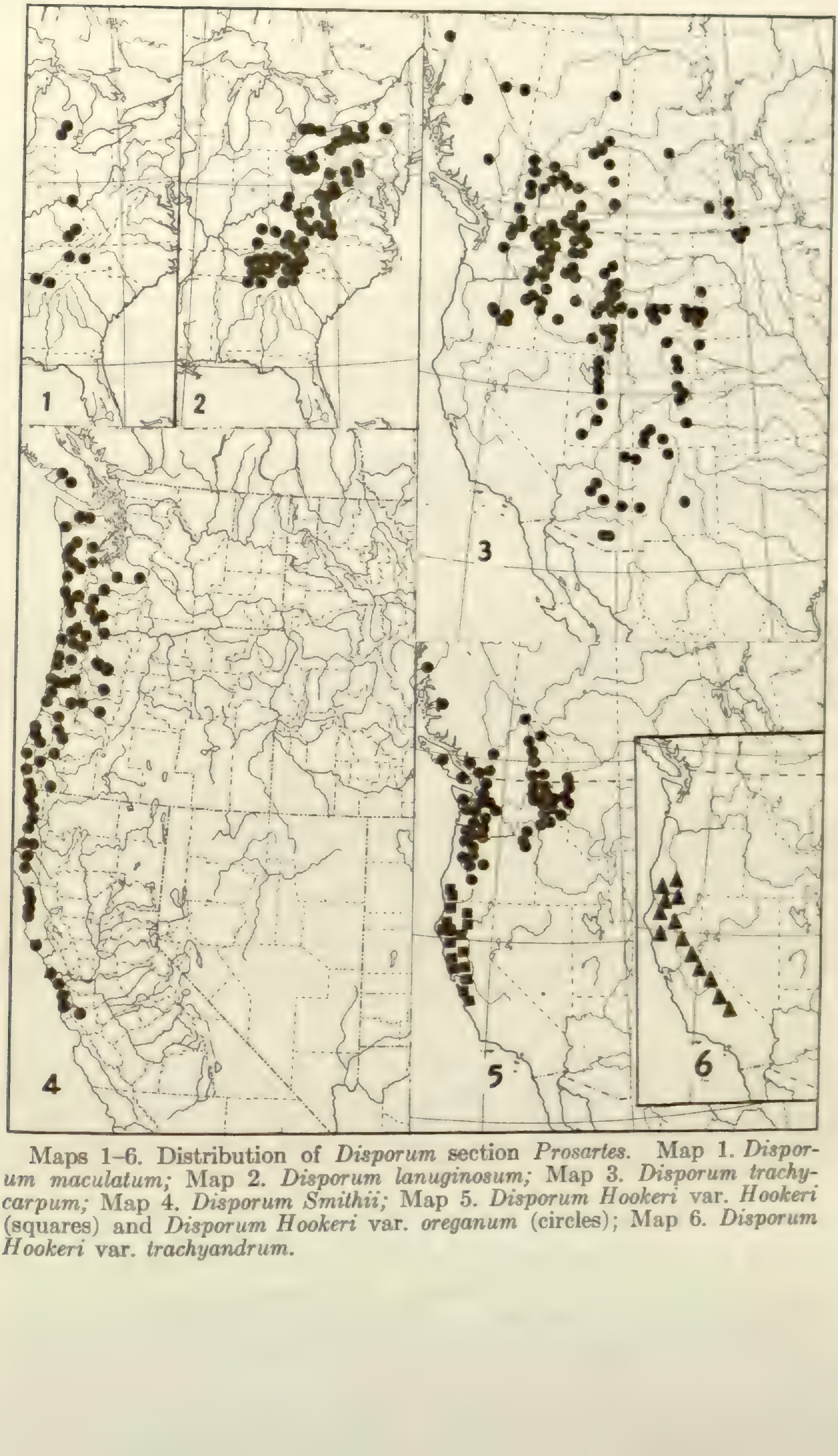
It is probable that *Disporum parvifolium* is a hybrid between *D. Hookeri* var. *Hookeri* and *D. Smithii*. It occurs in an area where the ranges of these overlap, it is morphologically intermediate between them, and it is sterile. Critical evidence would be its chromosome number, which has not been determined, but which could be expected to be $2n = 17$, the sum of the haploid numbers of the putative parents.

Distribution. In the mountains of southern Curry Co., Oregon, and northern Del Norte Co., California. CALIFORNIA. Del Norte Co.: E. base of Hazelview Summit Grade on Crescent City-Grants Pass road, May 19, 1929, *D. K. Kildale 7874* (D); Hazelview Summit, elev. 2800 ft., May 25, 1929, *Kildale 9176* (D); Siskiyou Mts., between Happy Camp and Waldo, June 16, 1879, *V. Rattan* (D, G, Type). OREGON. Curry Co.: Bear Wallow, 2500 ft., June 4, 1932, *L. Leach 3548* (D, WU); top of the Coast Mts., on the Oregon state line, southern Oregon, June 1884, *T. Howell* (UO); Coast Mts., forty-second parallel, June 13, 1884, *Howell* (D, NY, US, UW, WS); Coast Mts., June 9, 1884, *Howell* (G).

5. **Disporum lanuginosum** (Michaux) Nicholson.

Streptopus lanuginosus Michaux, Fl. Bor. Am. **1:** 201. 1803; *Uvularia lanuginosa* Persoon, Syn. Pl. **1:** 360. 1805; *Prosartes lanuginosa* D. Don in Trans. Linn. Soc. **18:** 532. 1841; *Disporum lanuginosum* Nicholson in Dict. Gard. **2:** 485. 1884. Type locality: "in altis montibus Carolinae meridionalis." **Type not seen.**

Plant 3 to 9 dm. tall. Leaves narrowly ovate to lanceolate, long-acuminate, 3 to 12 (to 15) cm. long, lower surface lanulose, the veins densely so, upper surface glabrate or the veins moderately pubescent, margins ciliate, the cilia pointing sharply forward. Flowers solitary to three in a cluster, greenish white, 12 to 20 mm. long; perianth turbinate, the segments lance-linear, slightly gibbous below. Stamens included; anthers about ⅓ as long as the strap-shaped, narrowly dilated filaments. Ovary narrowly ellipsoidal, glabrous or occasionally slightly hairy; ovules pendulous, 2 per locule. Style stout, terete, glabrous; stigma 3-cleft. Berry bright red, spherical; seeds commonly 2, occasionally 4 to 6.



Maps 1–6. Distribution of *Disporum* section *Prosartes*. Map 1. *Disporum maculatum;* Map 2. *Disporum lanuginosum;* Map 3. *Disporum trachycarpum;* Map 4. *Disporum Smithii;* Map 5. *Disporum Hookeri* var. *Hookeri* (squares) and *Disporum Hookeri* var. *oreganum* (circles); Map 6. *Disporum Hookeri* var. *trachyandrum.*

Disporum lanuginosum can be distinguished from the other members of the genus by the densely lanulose pubescence of the veins of the lower surface of the leaves. It is very closely allied to *D. Hookeri* of the West Coast and, were it not for the very distinct ranges of the two, they could be considered only varietally distinct. They are alike, morphologically, in their ellipsoidal ovaries, pendulous ovules, turbinate perianth, and sharp, forward-pointing hairs of the leaf-margins. The chromosome number, $2n = 18$ in both species, supports the morphological evidence of close phylogenetic relationship between them.

DISTRIBUTION. Rich soil in woods, Appalachian Mountains from northern Alabama to central New York, and in northern Ohio and southeastern Ontario (Map 2). ONTARIO. ELGIN Co.: Aylmer, May 24, 1899, *C. T. Scott* (RM, UM); St. Thomas, May 24, 1899, *G. L. Fisher* (UM). MIDDLESEX Co.: near London, May 25, 1893, *J. A. Balkwill* (UM). NORFOLK Co.: Tilsonburg, June 25, 1901, *J. Macoun 54100* (NY); Port Rowan, July 17, 1892, *Macoun* (NY); Port Dover Junction, July 4, 1882, *Macoun* (G). ALABAMA. MADISON Co.: E. slope of Monte Sano, near its N. end, Apr. 24, 1940, *R. M. Harper 3777* (G, M, NY, US). MARSHALL Co.: Guntersville, June 16, 1913, *A. H. Howell 812* (US). JACKSON Co.: near Pisgah, Sept. 15, 1899, *Biltmore Herbarium 742a* (US); Davis Swamp, Apr. 29, 1938, *L. V. Porter* (G). GEORGIA. FLOYD Co.: Cliffs of the Coosa near Rome, Apr. 24, 1901, *Biltmore Herbarium 742c* (US); Rome, *Chapman* (US). RABUN Co.: on N. Slopes of Rabun Bald, N. W. of its summit, May 18, 1947, *W. H. Duncan 7556* (UC). WALKER Co.: on E. side of Pigeon Mt., Aug. 1, 1900, *R. M. Harper 331* (NY, US). KENTUCKY. CUMBERLAND Co.: Vaughn Cr., Apr. 17, 1940, *E. L. Braun 2870* (NY). FAYETTE Co.: Lexington, in Mts., 1837, *C. W. Short* (NY). HARLAN Co.: Black Mt., May 23, 1932, June 30, 1933, *Braun* (G); Pine Mt., Aug., 1893, *T. H. Kearney 113* (G, M, P, US). LETCHER Co.: Collier's Cr., Black Mt., July 8, 1935, *Braun* (G). MADISON Co.: Dogfoot Springs, Berea, Aug. 8, 1935, *H. K. Svenson 7207* (G). WOLFE Co.: below Sky Bridge, Apr. 24, 1938, *F. T. McFarland & J. Lyle 4247* (M). MARYLAND. GARRETT Co,: July 23, 1878, *J. D. Smith* (US). NEW YORK. ALLEGHANY Co.: Alfred, May, 1909, *R. B. Brown* (D). CATTARAUGUS Co.: Upper Stoddard Brook, Aug. 5, 1926, *W. P. Alexander & H. D. House 13084* (G). CAYUGA Co.: Auburn, *J. Carey* (M). CHAUTAUQUA Co.: Bemus Point, Lake Chautauqua, Aug. 2, 1896, *J. R. Churchill* (G, M). CHENANGO Co.: Norwich, Half-Way-House, Aug. 14, Sept. 24, 1888, May 17, 1890, *Herbarium of the Cornell Bot. Club* (P); Oxford, Sept. 5, 1885, *F. V. Coville* (US). CORTLAND Co.: South Hill, June 26, 1939, *S. Smith, A. Leuchs, E. & M. Palmatier 1179* (UW). ERIE Co.: Orchard Park, May 20, 1886, *M. Heath* (NY); Buffalo, *G. W. Clinton* (CA, D, NY); along Eighteen-Mile Cr., Hamburg, Aug. 19, 1918, *F. W. Johnson 1694* (NY); Collins, Sept. 10, 1920, *A. E. Perkins* (RM). NIAGARA Co.: DeVaux Col-

lege Woods, Suspension Bridge, May 8, 1896, *E. C. Townsend* (WS). ONTARIO Co.: S. of Bristol Springs, May 21, 1938, *R. T. Clausen & G. R. Mandels 3433* (CLUC, NY); Hemlock Lake, May 21, 1915, *C. C. Thomas 3733* (G). TOMPKINS Co.: Caroline Hills, Aug. 8, 1881, *W. R. Dudley* (D); along Fall Cr., E. side, near Dryden line, Ithaca, Aug. 12, 1916, *A. J. Eames 6196* (G); 1 mi. S. E. of Brookton, July 24, 1918, *K. M. Wiegand & Eames 9628* (M); between Jacksonville and Waterburg, June 16, 1918, *Wiegand 9629* (G). WAYNE Co.: Lyons, May 23, 1871, *E. L. Hankenson* (D, G, NY). YATES Co.: Penn Yan, *H. P. Sartwell* (G, P). NORTH CAROLINA. BUNCOMBE Co.: Biltmore, Aug., 1895, *Biltmore Herbarium 742* (US); Busbee Mt., Apr. 23, 1897, *Biltmore Herbarium 742b* (G, M, NY, US, UW); vicinity of Montreat, Aug. 24, 1913, *P. C. Standley & H. C. Bollman 9997* (US). HAYWOOD Co.: Pigeon Gap Trail, July 3, 1909, *H. D. House 4150* (US); Double Spring Gap, June 15, 1910, *House 4455* (US); Richland Balsam Mts., May 21, 1911, *House 4573* (US); vicinity of Eagles Nest, near Waynesville, Sept. 5, 1910, *Standley 5517* (US). HENDERSON Co.: Hendersonville, July, 1911, *A. M. Huger* (M). JACKSON Co.: Black Mt., 1854, *Forster* (NY). MADISON Co.: near Hot Springs, Aug. 22, 1924, *L. E. Wehmeyer 744* (UM). MITCHELL Co.: in Roan Mts., July, 1841, *A. Gray & J. Carey* (G); Roan Mt., 1841, *Carey* (NY). POLK Co.: eastern slopes of Warrior Mt., W. of Tryon, June 16, 1942, *E. H. Walker 3352* (US). OHIO. CUYAHOGA Co.: Euclid, Apr. 25, 1896, *L. D. Stair* (M), May 15, 1895, *J. R. Watson* (D, G, M, P), June 1, 1895, *Watson* (G, NY, RM), June 15, 1895, *Watson* (RM, US). ERIE Co.: Florence Twp., May 18, 1895, *E. L. Moseley* (US); Berlin, Sept. 7, 1895, *Moseley* (G, US). LORAIN Co.: Oberlin, *A. J. Cook 108* (P), May 11, 1891, *C. A. Kofoid* (G), May 24, 1895, *A. E. Ricksecker* (US). PORTAGE Co.: Garrettsville, May 18, 1897, *R. J. Webb 206* (G). RICHLAND Co.: May 17, 1895, *E. Wilkinson 10368* (M, NY, UC, UW). Ross Co.: Tar Hollow, Colerain Twp., Aug. 10, 1936, *Bartley & Pontius 21* (NY), July 11, 1937, *G. S. Crowl* (NY). SCIOTO Co.: Camp Gordon C. C. C., Friendship, June 21, 1934, *D. Demaree 10748* (D, M, NY, US). WAYNE Co.: Myer's Hollow, Sept. 5, 1899, *A. D. Selby & J. W. T. Duvel 417* (NY). PENNSYLVANIA. CAMBRIA Co.: Stony Cr., S. of Johnstown, June 16, 1907, *E. B. Bartram* (NY). CENTER Co.: ½ mi. S. of Julian on Bald Eagle Range, May 11, 1939, *J. P. Kelly* (G). CLEARFIELD Co.: 2 mi. N. W. of DuBois, May 18, 1941, *H. A. Wahl 946* (CLUC, G, WS). ERIE Co.: Corry, June 2, 1893, *J. R. Churchill* (G, M); Erie, May 19, July, 1879, *H. N. Mertz* (NY, UM). FAYETTE Co.: Ohiopyle, Aug. 22, 1942, *Bright 19034 & 19035* (CLUC, WS); Normalville, May 15, 1937, *W. H. Emig* (M); South Connellsville, May 18, 1928, *J. F. Lewis 3834* (NY). HUNTINGDON Co.: ridge opposite Seminary, Birmingham, June, 1869, *N. J. Davis* (NY); INDIANA Co.: 2 mi. N. N. W. of Armagh, May 8, 1946, *Wahl 1666* (G). SOMERSET Co.: Buckstown, Sept. 12, 1942, *Bright 19056* (UW), *19067* (WS). WESTMORELAND Co.: Chestnut Ridge at Hillside, May 19, 1935, *Bright 12394* (WS), May 10, 1877, *P. E. Pierron* (US). SOUTH CAROLINA. OCONEE Co.: Tomassee Falls, May 5, 1906, *H. D. House 2084* (M). TENNESSEE. CLAIBORNE

Co.: Cumberland Gap, May 2, 1903, *Biltmore Herbarium 742* (US). Cocke Co.: within 3 mi. of Wolf Cr. Station, Sept. 6, 1897, *T. H. Kearney 917* (M, NY, US). Davidson Co.: Joelton, July 16, 1922, *H. K. Svenson 94* (M). Grainger Co.: vicinity of Lea Lakes near Blaine, Apr. 25, 1934, *H. M. Jennison 335* (M). Grundy Co.: limestone slope of Cumberland mt., below Monteagle, May 12, 1939, *Svenson 9917* (G). Hamilton Co.: Lookout Mt., "near the line between Tennessee and Georgia which crosses the Mt.," Apr. 21, 1906, *J. R. Churchill* (M). Knox Co.: Knoxville, June 5, 1900, *Ruth 454* (G, UC). Morgan Co.: Emory River, Apr. 23, 1893, *Kearney 71* (US). Polk Co.: May 4, 1928, *A. N. Leeds 1317* (M). Putnam Co.: near Monterey, May 2, 1942, *A. J. Sharp 1703* (M). Roane Co.: Harriman, Aug. 19, 1903, *Biltmore Herbarium 742f* (US); Oliver's Springs, May, 1897, *Ruth 1168* (NY). Sullivan Co.: Holston Mt., May 19, 1934, *Sharp, Jennison, J. K. Underwood 888* (CLUC). VIRGINIA. Augusta Co.: North River, vicinity of Staunton, May 6, 1934, *E. S. Rawlinson 185* (US). Bedford Co.: Montgomery, May 26, 1870, *A. H. Curtiss 8218* (M). Craig Co.: Alleghany Station, June 19, 1895, *ex herb. N. M. Glatfelter* (M). Giles Co.: Salt Pond Mt., May 30, 1890, *N. L. Britton et al* (NY, US); 1½ mi. N. E. of Mt. Lake P. O., July 26, 1937, *J. M. Fogg, Jr.* 12701 (G). Highland Co.: along Crab Run, W. of McDowell, Aug. 25, 1927, *E. T. Wherry & F. W. Pennell 13383* (M). Roanoke Co.: ridge of Poor Mt., about 5 mi. S. S. W. of Singer P. O., Sept. 10, 1942, *C. Wood, Jr. 5702* (UC). Smyth Co.: Walker Cr., May 23, 1892, *N. L. & E. G. Britton & A. M. Vail* (NY); White Top Mt., June 19, 1936, *W. H. Camp 1553* (NY); Stalie's Knob and Stalie's Cr., E. Marion, May 18–19, 1892, *Small* (M). Wise Co.: Big Stone Gap, May 5, 1903, *Biltmore Herbarium 742e* (US). Wythe Co.: June 7, 1872, *A. H. Curtiss* (M); bank of Reed Cr., May, 1874, *H. Shriver* (UM). WEST VIRGINIA. Barbour Co.: near Tygart Junction, Sept. 24, 1904, *J. M. Greenman 99* (G). Cabell Co.: Devil's Den Hollow, Milton, May 15, 1937, *L. Williams 578* (G, M, NY). Greenbrier Co.: White Sulphur Springs, May 17–18, 1909, *W. W. Eggleston 4343* (G, M, NY), *4357a* (NY, US). Kanawha Co.: East Banks, June 15, 1903, *Biltmore Herbarium 742g* (US). Mingo Co.: mouth of Little Huff Cr., July 10, 1930, *E. E. Berkeley* (G). Monongalia Co.: Gum Springs, May 19, 1944, *Mr. & Mrs. H. A. Davis 5991* (OS, WS). Monroe Co.: summit of Peter's Mt., July 4, 1933, *L. Griscom & F. W. Hunnewell 18681* (G); Pott's Mt., Aug. 31, 1903, *E. S. & Mrs. Steele 185* (US); Gap Mt., Sept. 2, 1903, *E. S. & Mrs. Steele 185* (NY). Pocahontas Co.: Elk Mt., May 26, 1933, *C. A. & U. F. Weatherby 6417* (G). Preston Co.: Aurora and vicinity, Sept. 6, 1898, *E. S. & Mrs. Steele* (US). Raleigh Co.: E. of Beckley 7 mi. on Route 41, May 17, 1940, *J. P. Tosh 114* (CLUC). Summers Co.: Horseshoe Bend, Hinton Mt., May 4, 1939, *Tosh* (CA). Wetzel Co.: Burton, June 22, 1878, *H. N. Mertz* (NY).

6. **Disporum Hookeri** (Torrey) Nicholson.

Plant 3 to 10 dm. tall. Leaves variable, lanceolate to ovate, long-acuminate to acute, mostly somewhat clasping, 3 to 14 cm. long, lower surface scabridulous or puberulent, upper surface sparsely so or glabrate,

margins ciliate, the cilia pointing sharply forward. Flowers solitary to 3 in a cluster, creamy white or greenish white, 9 to 20 mm. long; perianth turbinate, the segments oblanceolate, slightly gibbous below. Stamens included or exserted; filaments filiform; anthers hispidulous or glabrous, ¼ to ½ as long as the filaments. Ovary ellipsoidal, glabrous or lanulose; ovules pendulous, 2 per locule. Style filiform, glabrous or the lower ½ pubescent; stigma entire or occasionally slightly 3-cleft. Berry bright red, ovoid; seeds commonly 4 to 6, occasionally less than 4.

Key to Varieties

Anthers glabrous; ovary and style glabrous or pubescent.
- Leaf-apices mostly acute; stamens usually included; ovary and style usually glabrous. Curry Co., Oregon, south in the Siskiyou Mountains and in the Coast Ranges to Monterey Co., California.....6a. *D. H.* var. *Hookeri*
- Leaf-apices mostly long-acuminate; stamens usually well-exserted; ovary and style usually pubescent. Northern Jackson Co., Oregon, north in the Cascade Mountains and Coast Range to British Columbia, thence east to the western slopes of the Rocky Mountains.....6b. *D. H.* var. *oreganum.*

Anthers hispidulous; ovary and style glabrous or very rarely pubescent. Sierra Nevada, Siskiyou Mountains and North Coast Ranges.....6c. *D. H.* var. *trachyandrum.*

Disporum Hookeri, as considered here, consists of three well-marked geographical varieties which up until now have been considered as distinct species. The morphological characteristics which have been relied upon to separate the three, however, have not proved to be entirely constant, and this lack of constancy is believed to indicate gene flow between the entities, probably continuing up to the present time.

The most nearly distinct of the three entities is var. *oreganum*. This geographical race occurs in the Coast Range and Cascade Mountains from southwestern Oregon to British Columbia, and in the northern Rocky Mountains, and does not overlap either of the other varieties in distribution (Maps 5 and 6). It is generally characterized by a hairy ovary and style, exserted stamens with glabrous anthers, and acuminate leaf-apices, as well as by some more obscure features.

Variety *Hookeri* and var. *trachyandrum* are very closely related morphologically. Indeed, only a single character has been found which can be relied upon to separate them. Both of these varieties differ from var. *oreganum* in their usually glabrous ovary and style, included or little exserted stamens, and acute leaf-apices. They are separated from each other by glabrous anthers in var. *Hookeri* and hispid anthers in var. *trachyandrum*. Geographi-

cally, there is a broad zone of overlap in the North Coast Ranges and Siskiyou Mountains of northern California and southwestern Oregon. Outside of this area, var. *Hookeri* extends south in the Coast Ranges to Monterey County, California, and var. *trachyandrum*, south in the Sierra Nevada to Tulare County. Were it not for these significant extensions beyond the area of overlap, the difference between vars. *Hookeri* and *trachyandrum* would perhaps be considered inconsequential. The character which differentiates them is a tenuous one. The hispidity of the anthers in var. *trachyandrum* is variable in degree, and the presence of any hair whatsoever has been deemed sufficient to indicate this variety. When so considered, no collection has been found which includes plants with both hispid and completely glabrous anthers. The two varieties cannot be distinguished when sterile or in fruit. Such collections from the zone of overlap are not cited.

The characters which differentiate var. *oreganum* from the other varieties are not completely fixed, although the correlation of the several characters involved leaves little doubt as to the identity of individuals within the ranges assigned to the varieties. Of the characters mentioned, the presence or absence of hair on the ovary and style shows the poorest correlation with geographical distribution. Only about 80 per cent of the individuals of var. *oreganum* have hairy ovaries. In the remaining 20 per cent, these are glabrous. Indeed, glabrous and hairy ovaries may be found on different individuals of the same collection, such as *Shaw 27* (G, RM-hairy; NY, WS-glabrous).

The same situation prevails in var. *Hookeri*, except that the percentages are reversed, about 80 per cent of the individuals of this variety having glabrous ovaries while those of the remaining 20 per cent are hairy. Again, both conditions may be found in a single collection, for example, *C. F. Baker 650* (G, NY, P, UC-hairy; M, RM, US-glabrous) and *5052* (D, NY, RM, UC-hairy; G, P-glabrous).

Hairy ovaries also occur in var. *trachyandrum*, particularly in the area where this variety overlaps var. *Hookeri* in distribution and also most nearly approaches the present range of var. *oreganum*. Such collections as *Abrams & Benson 10452* (D), *Blankinship*, Apr. 15, 1923 (CA), and *Cooke 16021* (D) illustrate this condition.

The shape of the leaf-apices is much more reliable for separating vars. *Hookeri* and *trachyandrum* from var. *oreganum* than is the absence of hair on the ovary. However, acuminate leaf-apices occur in both of these varieties, for instance in var. *Hookeri* in *C. F. Baker 650* (RM), and *5052* (P). The remaining several individuals of these collections are typical of var. *Hookeri* in this respect. In var. *trachyandrum*, acuminate leaf-apices are found in the following unicate collections: *Abrams 10510* (D), *Holzinger 33* (US), and *Peck 24875* (WU). In these cases, more intangible characters such as the scabrousness of the leaf-surfaces and whether the cilia of the leaf margins are long- or short-pointed must be used to distinguish the plants from var. *oreganum* if they are not in flower.

The amount of exsertion of the stamens varies in each variety, with well exserted stamens being most frequent in var. *oreganum* but occurring in var. *Hookeri* in *Rose 39095* (CLUC, NY), and in var. *trachyandrum* in *Applegate 732* (G, US) and *Peck 24875* (WU).

The situation described indicates that there has been geographical and probably ecological differentiation of *Disporum Hookeri* into three nearly distinct morpho-geographic races, but that there has been sufficient gene flow between these races to prevent the attainment of the specific level of differentiation. Accordingly, the three are here treated as varieties of a single species.

6a. **Disporum Hookeri** var. **Hookeri**

Prosartes Hookeri Torrey in Pac. Railroad Rep. **4:** 144. 1857; *Prosartes lanuginosa* var. *Hookeri* Baker in Journ. Linn. Soc. **14:** 587. 1875; *Disporum Hookeri* Nicholson, Dict. Gard. **2:** 484. 1884. Based on a collection by Bigelow from the mountains near Oakland, California, Apr. 4, 1854. Probable type in Herb. N. Y. Bot. Gard. and probable isotype in Gray Herbarium studied.

Prosartes Hookeri var. *oblongifolium* Watson in Bot. Cal. **2:** 179. 1880. Type locality: "In the Coast Ranges from Marin County to Santa Cruz." Type not designated.

Leaf-apices usually acute; leaf-surfaces scabridulous; cilia of the margins short-pointed. Flowers 10 to 15 mm. long, greenish white. Stamens included or slightly exserted; anthers glabrous. Ovary glabrous or occasionally lanulose; style glabrous or occasionally the lower ½ lanulose, stigma entire.

Disporum Hookeri var. *Hookeri* can usually be distinguished from var. *oreganum* by its scabridulous leaf-surfaces, less acumi-

nate leaf-apices, and greenish white flowers with the stamens included or but slightly exserted. It can be distinguished from var. *trachyandrum* only in flower and then on the basis of its glabrous anthers.

Distribution. In shady places in forests and thickets, Siskiyou Mountains and Coast Ranges from Curry Co., Oregon, south to Monterey Co., California (Map 5). CALIFORNIA. Alameda Co.: Mts. near Oakland, Apr. 14, 1884, *J. M. Bigelow* (G, NY); Berkeley, Mar. 24, 1929, *J. W. Blankinship* (M); Redwood Ridge, Mar. 26, 1932, *L. Constance 470* (UC); upper Strawberry Canyon, Berkeley Hills, Sept. 24, 1933, *J. A. Ewan 7983* (M, P, UC). Contra Costa Co.: Curry-Cave Point trail, Apr. 22, 1933, *Bowerman 1888* (CA, UC); Alamo Canyon, east fork, Mar. 22, 1931, *Bowerman 606* (UC); S. of Mt. Diablo, May 16, 1860–62, *Brewer 1099* (G, M, UC, US); Moraga Valley, Apr. 21, 1929, *Mexia 2387* (P, RM, UC, US); ½ mi. E. of Oakland Tunnel, Mar. 8, 1948, *J. A. Rattenbury 96* (UC), Mar. 26, 1948, *104* (UC); Apr. 13, 1948, *111* (UC). Del Norte Co.: Adams Station, Waldo-Crescent City Road, Apr. 22–May 5, 1907, *A. Eastwood* (CA); trail up Klamath River to Blue Cr., July 14, 1929, *D. K. Kildale 8454* (D). Humboldt Co.: Richardson Grove, May 27, 1934, *E. Armstrong* (UC); Weott R. S., S. Fork Eel River, July 12, 1929, *Benson* (P); N. side of Bull Cr., Humboldt Redwood Park, May 29, 1934, *Constance 753* (WS); beyond Blue Lake, Arcata-Redding road, May 27, 1933, *L. F. Henderson 15452* (UO); near Canyon Park, July 22, 1926, *Kildale 2420* (D); Kneeland Prairie, June 9, 1908, *J. P. Tracy 2663* (UC); Grizzly Cr., on Van Duzen River, May 4, 1924, *Tracy 6670* (UC). Lake Co.: Mt. Hanna, Kelseyville, Apr. 29, 1928, *Benson 114* (P); on trail to Mt. Sanhedrin, May 25, 1925, *Eastwood 12954* (CA); Mt. Sanhedrin, S. W. of Old Frazier Mill, July 16, 1913, *H. M. Hall 9486* (UC); Pinnacle Rock, Bartlett Mt., June 20, 1945, *J. T. Howell 21118* (CA); Cobb P. O., Cobb Mt., Apr. 29, 1933, *M. S. Jussel* (CA). Marin Co.: Ross garden, Aug. 3, 1935, *H. C. Cantelow 1090* (CA); Mt. Tamalpais, Apr. 29, 1922, *J. C. Chamberlain* (UW); Mill Valley, Apr. 8, 1913, *I. J. Condit* (UC); Lagunitas Cr., Aug. 1894, *Eastwood* (G); Bear Valley, Mar. 28, 1926, *Eastwood* (CA); Saucelito, Mar., 1876, *H. Edwards* (NY); foot of Matt Davis Trail, ½ mi. from ocean, 1937, *J. A. Ewan 10210* (UW); west shore of Tomales Bay, 1 mi. S. of Inverness, July 19, 1935, *R. S. Ferris & I. L. Wiggins 8082* (D, G, WS); bluff beyond Point Reyes, May 21, 1933, *Henderson 15441* (UO); Pipeline Trail, Apr. 5, 1925, *Howell 952* (CA); Tocaloma, Apr. 4, 1917, *H. L. Mason 75* (D); El Campo, July, 1892, *Michener & Bioletti* (NY); Camp Taylor, May 8, 1886, *V. Rattan* (D); San Rafael, Feb. 24, 1877, *V. Rattan* (D); Big Rock Ridge, about 3 mi. W. of Hamilton Field Air Base, Apr. 4, 1944, *G. T. Robbins 1519* (UC); 1 mi. N. of La Honda, Apr. 8, 1950, *G. H. Ward 949* (WS). Mendocino Co.: South Mill Cr. Canyon near Ukiah on road to Carl Purdy's, Apr. 28, 1918, *L. R. Abrams 6939* (D); midway between the Humboldt Co. line and Laytonville, July 20, 1929, *Benson 1884* (P); near Mendocino, May, 1898, *H. E. Brown 751* (M, NY,

UC, US); near Bell Springs, June 22, 1937, *Eastwood & Howell 4698* (CA); near Cumming's P. O., July 7, 1938, *Eastwood & Howell 6119* (CA, UW); Kaisen District, Apr. or May, 1903, *J. McMurphy 175* (D, NY); Casper, Camp 19, T. 17 N., R. 16 W., *R. Stahelin* (VTM). Monterey Co.: Cruikshank Cr., Aug. 11, 1910, *I. J. Condit* (UC); Pajaro River, Apr. 5, 1915, *Eastwood 4176* (CA, US); Santa Lucia Mts., Mar., 1898, *R. A. Plaskett 38* (NY, US). Napa Co.: Rebecca Ranch grade, Napa River basin, 1894, *W. L. Jepson* (UC); Napa, 1899, *H. Smyth* (G); among the hills E. of Napa, July 26, 1913, *Suksdorf 682* (G, WS). San Francisco Co.: S. of Golden Gate Park, Mar. 29, 1891, *E. Cannon* (CA); Sutro Forest, San Francisco, Aug., 1929, *H. W. Clark* (CA). San Mateo Co.: King's Mt., May 20, 1902, *L. R. Abrams 2467* (D); Crystal Springs Lake, Apr. 6, 1902, *C. F. Baker 650* (G, M, NY, P, RM, UC, US), Apr., 1903, *Baker 5052* (D, G, NY, P, RM, UC); San Francisquito Cr., Santa Cruz Mts., Woodside, Feb. 28, 1931, *Benson 2614* (P); Bear Gulch Road, Santa Cruz Mts., Apr. 1, 1893, *W. R. Dudley* (D, P); near lumber camp on El Corte de Madera Cr., Sept. 15, 1895, *Dudley* (D); near Searsville, Apr. 15, 1898, *Dudley* (D); El Corte de Madera Cr., Apr. 24, 1898, *Dudley* (D); Devil's Canyon near Black Mt., Aug. 13, 1894, *C. F. Leithold* (D); San Mateo Canyon, May 5, 1939, *L. S. Rose 39095* (CLUC, M, NY). Santa Clara Co.: Stanford University, Apr., 1898, *Abrams* (D); Steven's Cr., July, 1901, *W. S. Atkinson* (D); foothills, W. of Los Gatos, Apr. 6, 1904, *A. A. Heller* (G, M, NY, UC, US); Uvas Canyon, Apr. 18, 1926, *J. T. Howell 1911* (CA); Fire Trail, Apr. 20, 1940, *E. H. Nelson 83* (UC); Raymonds Ranch, Los Gatos, June 20, 1914, *G. Newell* (CA, G); San Jose Canyon, July 2, 1907, *Patterson & Wiltz* (D); W. of Saratoga, T. 7 S., R. 2 W., Aug. 7, 1929, *C. F. Raymond 28* (VTM); Mt. Hamilton, May 11, 1895, *C. Rutter 3* (US). Santa Cruz Co.: Felton, Santa Cruz Mts., Apr. 27, 1935, *Benson 6446* (P); California Redwood Park, Apr. 7, 1917, *A. C. Brown* (UW); Glenwood, 1914, *H. Davis* (CA, G, M, US); Swanton, Mar. 6, 1912, *W. H. Rich* (D, UW); near De Laveaga Park, Apr. 3, 1914, *R. Stinchfield 152* (D); Sulphur Springs, near Soquel, May 1, 1902, *C. H. Thompson* (D, M); Santa Cruz, June 16, 1903, *Thompson* (M); 10 mi. E. of Watsonville, 1866, *A. Wood* (G). Siskiyou Co.: Eldridge's Corral, Russian Cr., Aug. 24, 1908, *G. D. Butler 93* (D, UC); Kidder Cr., Apr. 22, 1910, *Butler 1222* (P); Salmon Mts., Aug. 24, 1901, *W. R. Dudley* (D); Soda Cr. Canyon, July 30, 1921, *Eastwood 11031* (CA); Rattlesnake Meadow, trail to Preston Peak, Aug. 24, 1929, *Kildale 9078* (D); Jayne's Canyon, Sec. 5, T. 47 N., R. 9 W., Aug. 10, 1934, *L. C. Wheeler 3104* (NY, US). Sonoma Co.: 1 mi. W. of Camp Meeker, T. 7 N., R. 10 W., Mar. 26, 1934, *E. Armstrong 902* (VTM); road between Forestville and Guerneville, Apr. 2, 1898, *M. S. Baker* (UC); Sonoma Cr. Canyon, June 20, 1904, *Baker* (UC); Santa Rosa, Mar.–Apr., 1880, *J. W. Congdon* (D); western base of Mt. Hood, Mar. 27, 1902, *Heller & Brown 5164* (D, G, M, NY, US); Bodega Bay, Apr. 11, 1902, *Heller & Brown 5273* (D, NY, US); Monte Rio, Aug., 1912, *C. M. Hoak* (UC); Duncan Mills, July 8, 1882, *M. E. Jones* (P); Russian River Station, Aug., 1900, *G. A. Newell* (G); near

Cloverdale, June 25, 1877, *V. Rattan* (D). TRINITY Co.: Hay fork, Apr. 24, 1924, *Hay Fork School* (CA). OREGON. CURRY Co.: 2 mi. beyond Carpenterville on old road, May 17, 1929, *L. F. Henderson 10135* (UO); top of Mt. Emily, near Chatco River, July 13, 1929, *Henderson 11674* (UO).

6b. **Disporum Hookeri** var. **oreganum** (Watson) comb. nov.

Prosartes oregana Watson in Proc. Am. Acad. **14:** 271. 1879; *Disporum major* Britton in Bull. Torrey Bot. Club **15:** 188. 1888, excl. name-bringing synonym; *Disporum oreganum* Miller in Bailey, Cyclop. Am. Hort. 496. 1900. Type not designated, but the original description unmistakably refers to this plant.

Leaf-apices acuminate or long-acuminate; lower leaf-surface puberulent; cilia of the margins usually long-pointed. Flowers 12 to 20 mm. long, creamy white. Stamens usually well exserted; anthers glabrous. Ovary lanulose or occasionally glabrous; style lanulose below the middle or rarely glabrous; stigma entire or occasionally slightly 3-cleft.

DISTRIBUTION. In damp, shady woods, from northern Jackson Co., Oregon, north in the Coast Range and Cascade Mountains of Oregon, Washington, and British Columbia, east to Idaho, western Montana and southwestern Alberta (Map 5). ALBERTA. MCCLEOD DIST.: Waterton Lake, July 27, 1895, *J. Macoun 13834* (NY). BRITISH COLUMBIA. CARIBOO DIST.: Alexandra Bridge, Frazer River Canyon, Apr. 18, 1934, *T. T. McCabe 729* (UC, UW); Hargreaves Ranch, Mt. Robson, Aug. 19–28, 1943, *E. Scamman 3244* (G). COMOX-ALBERNI DIST.: Alberni, May, 1915, *W. R. Carter 155* (G, US). EAST KOOTENAY DIST.: flats at mouth of Gold River, June 9, 1911, *F. K. Butters & E. W. D. Holway* (G); Glacier, above the snow fields, Aug. 14, 1913, *Butters & Holway 823* (G); Illecillewaet Valley, Loop Trail, June 22, 1906, *S. Brown 262* (G, M, NY, US); Beaver Valley, Aug. 18, 1904, *E. R. Heacock 527* (G, M, NY, US); flood plains of Columbia at Beavermouth, Aug. 18, 1905, *C. H. Shaw 1158* (G, M, NY); Emerald Lake, June 25, 1904, *R. T. Shaw 27* (G, M, NY, RM, US, WS). FRASER VALLEY DIST.: Crescent, near Blaine, Wash., Aug. 1, 3, 1914, *J. K. Henry 1219* (CA, RM); Cheekye, May 6, 1923, *W. H. Kee* (WS); Chilliwack Valley, June 15, 1901, *J. M. Macoun 54084* (G, NY); Alta Lake, Aug. 26, 1935, *McCabe 2825* (UC); Huntingdon, Apr. 26, 1936, *McCabe 3315* (UC); Harrison, May 19, 1902, *W. Spreadbrogh 70192* (NY). KAMLOOPS DIST.: Revelstoke, May 13, 1890, *Macoun* (M, US); Grizzly Peak, 8 mi. W. of Clearwater, June 10, 1935, *McCabe 2285c* (UC). KOOTENAY DIST.: Sheep Cr., Aug. 19, 1935, *F. A. MacFadden 14061* (CA); 13 mi. W. of Kaslo, June 6, 1938, *McCabe 6561* (UC); 8 mi. N. of Trail, May 10, 1938, *McCabe 6851* (UC, UW); Balfour, May 15, 1938, *McCabe 6900* (UC). NANAIMO DIST.: Goldstream, Vancouver, Is., July 18, 1914, *J. R. Anderson* (WS); Cowichan Lake, Vancouver Is., July, 1916, *Anderson* (WS); Cedar Hill, Vancouver Is., May 26, 1887, *Macoun* (NY); Victoria, May 25, 1896, *A. J. Pineo* (P, UC). SKEENA DIST.: Skeena, Sept. 12, 1910, *Anderson* (WS); Bella Coola, May 11, 1933, *McCabe 51* (UC). VANCOUVER NORTH DIST.: Queen Charlotte's Islands, June, 1878, *G. M. Dawson* (G);

Spanish Banks, Vancouver, May 7, 1944, *J. W. Eastham* (WS); New Westminster, May 3, 1915, *Henry 9124* (RM). IDAHO. Benewah Co.: Alder Cr., May 16, 1926, *G. N. Jones 492* (WS); along Soldier Cr., at its mouth, Sec. 5, T. 44 N., R. 1 W., about 10 mi. N. E. of Emida, May 28, 1949, *M. Ownbey & Q. Jones 3191* (WS). Bonner Co.: 5 mi. W. of Sand Point, Aug. 16, 1922, *J. H. Ehlers & C. O. Erlanson 66* (UM); Priest River Expt. Sta., July, 1923, *C. C. Epling 5732* (M, OS, US); Orogrande Cr., Clearwater Fork, July 12, 1926, *Epling 9328* (M, OS); MacAbee's Ranch, Priest River Valley, July 23, 1900, *D. T. MacDougal 86* (NY); Kaniksu Forest, Sec. 4, T. 57 N., R. 5 W., May 24, 1925, *J. C. Witham 19* (WS). Boundary Co.: Near Copeland, Aug. 22, 1922, *Ehlers & Erlanson 203* (UM); along Smith Cr., 10 mi. W. of Port Hill, July 18, 1936, *G. B. & R. P. Rossbach 281* (D); Bonner's Ferry, May 21, 1903, *K. Whited 1475* (OS). Clearwater Co.: 8 mi. N. E. of Elk River, July 21, 1948, *M. Hafercamp & X. M. Gaines 107* (WS); along N. Fork of Clearwater River, some miles above Ahsahka, May 8, 1949, *Ownbey 3174* (WS). Idaho Co.: Meadow Cr., above Selway Falls, May 31, 1936, *L. Constance & R. C. Rollins 1653* (UW, WS). Kootenai Co.: Chatcolet, June 25, July 10, 1904, *C. Cozier* (WS); St. Maries, Aug. 11, 1912, *H. D. House 4936* (US); S. end of Lake Pend Oreille, July, 1891, *Leiberg 570* (UC, UO). Latah Co.: Moscow Mts., May, 1900, *L. R. Abrams 847* (D); Main Ridge, Mica Mts., Aug. 22, 1911, *Beattie 4520* (RM, WS); 1 mi. S. of Troy, May 27, 1944, *C. L. Hitchcock & C. V. Muhlick 8403* (NY, UW, WS); near junction of Ruby Cr. with E. Fork of Potlach Cr., Sec. 18, T. 40 N., R. 1 E., about 5 mi. S. of Boville, May 15, 1949, *Ownbey & Jones 3178* (WS); 1 mi. E. of Harvard, May 28, 1949, *Ownbey & Jones 3188* (WS). Nez Perce Co.: about Lake Waha, June 3–4, 1896, *A. A. & E. G. Heller 3183* (M, UC, US). Shoshone Co.: below the forks of Fishhook Cr., May 19, 1940, *Ownbey 2047* (CA, D, G, M, NY, OS, P, UC, UW, US, WS); about 4 mi. from the Little North Fork of the Clearwater River, Sec. 20, or 29, T. 43 N., R. 5 E., Aug. 4, 1941, *C. B. Wilson 427* (WS); vicinity of Little Baldy Lookout, Sec. 18, T. 50 N., R. 5 E, July 4, 1946, *J. G. Witt 1037* (UW, WS). MONTANA. Flathead Co.: McDonald Cr., Flathead River, July 20, 1933, *L. Benson 5329* (P); Big Fork, July 8, 24, 1908, *B. T. Butler 905, 906, 908, 929* (NY); July 18, 1908, *J. Clemens* (CA); Swan Lake, Aug. 25, 1908, *Clemens* (D, M); Yellow Bay, Aug. 11, 1908, *M. E. Jones 9192, 9195* (P); vicinity of Glacier Hotel, at the head of Lake McDonald, Aug. 23, 1919, *P. C. Standley 17970* (US); Avalanche Lake and vicinity, Aug. 29, 1919, *Standley 18455* (US); vicinity of Belton, Sept. 3–4, 1919, *Standley 18743* (US); Columbia Falls, June 5, 1893, *R. S. Williams 21* (US). Glacier Co.: Blackfoot Glacier, Sept. 1, 1909, *Jones* (P); vicinity of Grinnell Lake, July 8, 1919, *Standley 15214* (US); Iceberg Trail, vicinity of Lake McDermott, July 14, 1919, *Standley 15645* (US); vicinity of Going-to-the-Sun Chalets, on St. Mary Lake, Aug. 6–7, 1919, *Standley 17064* (US); Midvale, June 17–18, 1903, *Umbach 99* (D, NY, RM, US); Two-Medicine Lake, Glacier National Park, July 2, 1930, *E. C. VanDyke* (CA). Lake Co.: Mission Mts., near St. Mary Lake, Aug. 21, 1921, *J. E. Kirkwood 1066* (CLUC, G, M,

UC). RAVALLI Co.: Skalkaho Cr., S. E. of Hamilton, Aug. 27, 1935, *F. H. Rose 273* (WS). SANDERS Co.: near Heron, Aug. 31, 1895, *J. B. Leiberg 1630* (NY, UO, US). OREGON. BENTON Co.: Brook Lane, Apr. 13, 1915, *O. Elmer* (OS); Mary's Peak, Philomath, Apr. 29, 1922, *C. C. Epling & Shorett 5043* (M); S. of Crystal Lake Cemetery, Corvallis, May 1, 1916, *H. C. Gilbert 356* (OS); 9 mi. N. of Corvallis, Apr. 25, 1936, *Javete* (WS). CLACKAMAS Co.: Mt. Hood National Forest, exact locality unknown, June 1927, *E. L. Evinger 33* (OS); Summit R. S., Swim, June 21, 1927, *Evinger 35* (OS); Horse Thief Meadows, June 28, 1927, *Gooding & Evinger 34* (OS); Apr. 18, 1925, *F. Robinson* (D); near Lake Oswego, May 6, 1928, *J. W. Thompson 4141* (D, G, M, P, US). COLUMBIA Co.: along Clatskanie Cr., near Clatskanie, May 15, 1927, *Thompson 2433* (UW). CROOK Co.: Apr. 13, 1924, *Whited Collection 1093* (G). HOOD RIVER Co.: Dry Falls Cr. Trail, Cascade Locks, Apr. 30, 1936, *T. Gustafson 60* (OS); Hood River, May 16, 1915, *Jackson* (OS); Lost Lake, June 26, 1921, *M. E. Peck 10920* (WU). JACKSON Co.: Hershberger-Brown's Cabin Trail, near Rabbit Ears, July 13, 1929, *E. I. Applegate 6005* (D); Hershberger Mt., July 5, 1928, *F. P. Sipe* (OS). KLAMATH Co.: Annie Cr., Crater Lake National Park, Aug. 22, 1936, *Applegate 10904* (D). LANE Co.: Calapooya Range, Fairview Mt., July 4, 1948, *W. H. Baker 5546* (OS, UC); Calapooya Range, Bohemia Mt., July 4, 1948, *Baker 5569* (OS); Spencer Butte, July 16, 1933, *R. Brown 90* (UO); vicinity of Eugene, Apr. 30, 1927, *L. Constance* (UC); Springfield, May 2, 1938, *L. E. Detling 2589* (UO); Marten Ridge, Apr. 22, 1939, *Detling 3543* (UO); 3 mi. from Lowell, up Williamette bluffs, Apr. 7, July 5, 1934, *Henderson 16152* (UO); ¼ mi. from Big Fall Cr., May 23, 1938, *Henderson 18604* (UO). LINN Co.: Browsler Ridge, near Fish Lake, Aug. 22, 1897, *F. V. Coville & Applegate 614* (US); "Douglas Fir grove," Sept., 1933, *H. M. Gilkey* (D, OS). MARION Co.: Vitae Springs, near Salem, May 20, 1922, *E. Fairchild* (P); Santiam River, Detroit, Aug. 18, 1910, *Peck 1671* (WU). MULTNOMAH Co.: King's Heights, Portland, May 30, 1918, *J. F. Collins* (G); near Multnomah Falls, June 25, 1911, *Peck 2051* (WU); Bridal Veil, July 16, 1885, *Suksdorf* (WS). POLK Co.: Fall City, Apr. 17, 1915, *J. C. Nelson 60* (D); Coast Mt., near Monmouth, June 1893, *W. J. Spillman* (UW); near Independence, Apr. 21, 1894, *Spillman* (WS). UMATILLA Co.: Weston, 1897, *M. S. Baker* (UC); Scout Camp, 15 mi. E. of Milton, Apr. 26, 1942, *E. Booth* (WS); Bingham Springs, May 13, 1930, *J. R. Leach 2746* (UO); 5 mi. W. of Meacham, July 25, 1915, *Peck 4717* (WU). UNION Co.: 6 mi. W. of Summerville, June 1, 1933, *R. Sprague* (OS). WASHINGTON Co.: Gall's Peak, Forest Grove, June 1, 1893, *Lloyd* (NY). WASHINGTON. CHELAN Co.: Eight-Mile Canyon, about 8 mi. S. of Leavenworth, May 26, 1945, *C. L. Hitchcock 11398* (UW); Entiat Valley, Aug. 12, 1933, *G. E. Morrill 287* (UW); Lake Wenatchee, Aug. 1, 1893, *J. H. Sandberg & J. B. Leiberg 644* (G, NY, UC, UO, US, WS); Horseshoe Basin, July 12, 1923, *H. St. John & L. Ridout 3580* (WS); Lookout Mt. near Leavenworth, May 23, 1931, *J. W. Thompson 6511* (G, M, OS, UW). CLALLAM Co.: Olympic Mts., July, 1900, *A. D. E. Elmer 2497* (D, M, NY, US, WS); Dungeness Canyon, foothills Olympic range,

May 26, 1905, *J. M. Grant 138* (G, WS); Olympic Hot Springs, July 1, 1933, *G. N. Jones 3983* (UW); Hurricane Ridge, Elwha River Range, July 2, 1933, *Jones 4021* (UW); Soleduck River, Aug. 23, 1935, *Jones 8378* (UW). Clark Co.: near Camas, Apr. 15, 1932, *Thompson 8122* (M, NY, US, UW). Columbia Co.: Tucanon River, T. 9 N., R. 41 E., June 29, 1913, *H. T. Darlington 221* (WS); Blue Mts., Aug. 7, 1897, *R. M. Horner R472B488* (G). Cowlitz Co.: 2 mi. W. of Kalama, May 14, 1938, *Thompson 14267* (CA, D, M, NY, UC, US, UW). Grays Harbor Co.: 3 mi. up Baldy Trail above Quinault Lake, June 5, 1949, *Q. Jones 7* (WS); Mt. Colonel Bob, Olympic Mts., July 12, 1933, *Thompson 9411* (NY, UW), Aug. 23, 1933, *Thompson 9974* (UW). Jefferson Co.: Quilcene, Aug. 16, 1910, *R. K. Beattie 8644* (WS); Hoh River, Apr. 17, 1934, *O. J. Murie 1151* (M). King Co.: Three Tree Point, Puget Sound, May 10, 1929, *L. Benson 1329, 1338* (D, P); Magnolia Bluff, Seattle, June 4, 1929, *Benson 1538* (D, P); Scenic, July, 1910, *C. E. Clegg* (CA); Maloney's Grove, North Bend, May 10, 1935, *O. T. Edwards* (M, WS); Seacoma Beach, May 21, 1910, *C. Grainger 186* (UW); Seattle, Apr. 29, 1911, *M. Hall* (UW); near N. P. overhead crossing, ½ mi. E. of Issaquah, June 3, 1949, *Q. Jones 3* (WS); Renton, Apr. 16, 1910, *W. V. Lovitt* (UW); S. Fork Snoqualmie River, June 18, 1916, *L. S. Rosenbaum* (CA). Kittitas Co.: 1 mi. below Stafford Forest Camp, May 27, 1939, *Hitchcock & J. S. Martin 4693* (D, NY, UC, UW, WS); Ellensburg, May 27, 1904, *E. Schuyler* (WS); Redtop Mt., Wenatchee National Forest, July 4, 1933, *Thompson 9298* (UW); Cle Elum, May 12, 1897, *K. Whited* (WS). Klickitat Co.: Trout Lake, Aug., 1923, *G. A. Pearson 390* (P, WS); Randall's Ranch, May 6, 1886, *W. N. Suksdorf* (WS); between Dead Canyon and Falcon Valley, May 7, 1886, *Suksdorf* (WS); W. Klickitat Co., May 11, 1886, *Suksdorf 901* (M, NY, UC, US, UW, WS); White Salmon River, Apr. 11, 1892, *Suksdorf* (UW, WS); Bingen Mt., Bingen, Apr. 26, July 12, 1895, *Suksdorf* (UW, WS); Trout Lake Valley, along the trail to the "Schonberg" (Sleeping Beauty), Aug. 8, 1899, *Suksdorf* (WS). Lewis Co.: Centralia, May 6, 1927, *R. M. Owen* (WS). Mason Co,: Lake Cushman, Aug. 1895, *Piper* (G, WS). Pend Oreille Co.: Davis Ranch, foot of Mt., Carleton, July 25, 1902, *F. O. Kreager 309* (WS); Frontier, Aug. 19, 1902, *Kreager 468* (in part) (US); N. side of Pend Oreille River, Dalkena-Newport, May 11, 1923, *C. H. Spiegelberg 93* (WS); 8 mi. W. of Locke, May 17, 1923, *Spiegelberg 86* (WS); along Pend Oreille Lake, May 23, 1923, *Sprague 135* (WS). Pierce Co.: upper valley of the Nisqually, May 27, 1895, *O. D. Allen 148* (D, G, M, NY, P, RM, UC, US, WS); Tacoma, May 20, 1911, *E. M. Bardell* (M); Cougar Rock, Mt. Rainier, Aug. 5, 1933, *Benson 5639* (P); E. side of Steilacoom Lake, near Clover Cr., May 12, 1940, *Clover Park Junior-Senior High School* (UO); Nisqually Indian Reservation, May 16, 1937, *W. J. Eyerdam* (UC); South Prairie May, 1890, *L. Hardy* (NY); W. bank of Wind River, flat above Trapper Cr., May 4, 1925, *D. C. Ingram 1779* (OS, UO, WS). Skagit Co.: Pack Demonstration Forest, May 29, 1933, *A. & R. Nelson 681* (M, RM); Sedro-Wooley, May 4, 1919, *T. Roush* (D). Skamania Co.: hills back of Underwood, May 1, 1911, *Beattie 3815, 3817*

(WS); Wind River Forestry Sta., June 20, 1925, *Eastwood 13031* (CA); Mt. St. Helens, July 4, 1922, *M. W. Gorman 5834* (WS); Butterfly Lake, July 10, 1891, *Suksdorf* (WS); near Peter's Prairie, Oct. 2, 1892, *Suksdorf* (WS); Prindle, May 8, 9, 1912, *Suksdorf 7481, 7485* (WS); Cape Horn, Apr. 29, 1920, *Suksdorf 10401* (UW, WS). SNOHOMISH CO.: Silverton, 1899, *L. H. Bouck 181* (WS); Camano Is., May, 1895, *N. L. Gardner* (UC); Marysville, June, 1927, *J. M. Grant* (P); Steven's Pass region, Cascade Mts., May, 1929, *Grant* (UC); Snoqualmie National Forest, Aug. 8, 1938, *E. A. Purer 7713* (D, CLUC, M); Index, July, 1898, *T. E. Savage, J. E. Cameron & F. E. Lenocker* (M); below the glacier near Darrington, July 31, 1933, *Thompson 9638* (D, M, NY, P, UC, UW); near Big Four Inn, Cascade Mts., May 18, 1940, *Thompson 14538* (CA, CLUC, D, G, M, NY, UW, WS). SPOKANE CO.: Hangman Cr., Aug. 2, 1889, *Suksdorf* (WS); Liberty Lake, May 18, 1932, *M. Milburge 350* (UW). STEVENS CO.: Columbia River Valley, 6 mi. N. E. of Northport, July 7, 1932, *G. G. Hedgecock* (UW, WS); 10 mi. N. E. of Colville, May 22, 1923, *Spiegelberg 89* (WS). THURSTON CO.: Percival's Cr., May 2, 1905, *Otis 282* (WS); May 10, 1905, *Otis 317* (WS); roadside between Olympia and Nisqually, May 9, 1931, *Thompson 6268* (D, G, M, OS, P, UW); Tumwater, Apr. 26, May 2, 1904, *E. C. Townsend* (M, UC, UW, WS). WALLA WALLA CO.: Blue Mts., July 7, 1896, *Piper* (WS). WHATCOM CO.: Mt. Baker Highway, Mt. Baker National Forest, June 24, 1927, *E. Hardin 203* (WS); above Glacier, June 2, 1933, *W. C. & M. W. Muenscher 5730* (UC, WS); Church Mt., June 9, 1939, *W. C. Muenscher 9836* (D); Twin Lakes, Winchester Mt., Sept. 10, 1927, *H. St. John 9041* (WS); McLeod Lake, July 20, 1890, *Suksdorf* (WS). YAKIMA CO.: Yakima region, Apr. 1882, *T. S. Brandegee 45* (M, UC); upper Nachez and Stampede Pass, June 15, Oct. 4, 1892, *L. F. Henderson* (UW, WS); American River Canyon near Union Cr., June 21, 1936, *Eastwood & J. T. Howell 3017* (CA); "Breitenberg," S. of Mt. Adams, May 15, 1897, *Suksdorf* (UW, WS).

6c. **Disporum Hookeri** var. **trachyandrum** (Torrey) comb. nov.

Prosartes trachyandra Torrey in Pac. Railroad Rep. **4:** 144. 1857; *Prosartes lanuginosa* var. *trachyandra* Baker in Journ. Linn. Soc. **14:** 587. 1875; *Disporum trachyandrum* Britton in Bull. Torrey Bot. Club **15:** 188. 1888. Based on a collection by Bigelow from Duffield's Ranch, Sierra Nevada, May 10, 1854. Type in Herb. N. Y. Bot. Gard. and isotype in Gray Herbarium studied.

Leaf-apices usually acute; leaf-surfaces scabridulous; cilia of the margins short-pointed. Flowers mostly 9 to 12 mm. long, creamy white or greenish white. Stamens equaling the perianth-segments or slightly exserted; anthers hispidulous. Ovary glabrous or rarely hairy; style glabrous; stigma entire.

DISTRIBUTION. Moist, shady places in coniferous forests, from Douglas Co., Oregon, south in the Siskiyou and Sierra Nevada mountains to Tulare Co., and in the North Coast Ranges to Lake Co., California (Map 6). CALIFORNIA. AMADOR CO.: T. 8 N., R. 15 E., June 4, 1936, *R. P. Allen*

764 (UC); Panther Cr., 1895, *G. Hansen 1081* (D, M). Butte Co.: Brush Cr., 1907, *K. Conger* (P); above Paradise, May 18, 1935, *L. Whitaker* (OS). Calaveras Co.: Big Trees, Stanislaus Forest, June 4–5, 1913, *W. W. Eggleston 9213* (US). Del Norte Co.: Monumental, Apr. 29–May 5, 1907, *A. Eastwood 141* (CA). El Dorado Co.: ¼ mi. N. W. of Riverton, Sec. 30, T. 11 N., R. 14 E., June 7, 1934, *P. L. Johannsen & A. D. Gifford 259* (VTM); above Silver Fork American River, 2–3 mi. S. of Kyburz, June 4, 1943, *G. T. Robbins 1114* (CA, UC). Fresno Co.: Snow Cr., above Cascada, July 6, 1917, *Grant 1057* (M, P). Glenn Co.: Canyon of Snow Basin Cr., Aug. 11, 1943, *J. T. Howell 19279* (CA). Humboldt Co.: Branman Mt. near Willow Cr., June 15, 1918, *L. R. Abrams 7107* (D); Horse Mt., June 13, 1938, *J. P. Tracy 15898* (UC). Lake Co.: Saratoga Springs, Apr. 15, 1923, *J. W. Blankinship* (CA). Madera Co.: Ellis Meadows, *K. Brandegee* (UC). Mariposa Co.: Mt. Buckingham, Apr., 1883, *J. W. Congdon* (D); Futman (?) Mt., May 13, 1894, *Congdon* (UC); Bridal Veil Meadows, June 4, 1911, *H. M. Hall 8851* (UC); Wawona road to the Big Trees, Wawona Valley, June 8, 1924, *Howell 388* (CA); Camp Baxter, 20 mi. from Dorrington, July 13, 1930, *M. S. Jussel* (CA). Mendocino Co.: about 300 ft. below Summit, near creek, May–Aug., 1899, *J. B. Davy & W. C. Blasdale 5838* (UC). Nevada Co.: "God's Country," June 14, 1893, *Dudley* (D); Emigrant Gap, June, 1882, *M. E. Jones* (NY, P). Placer Co.: Dutch Flat, Apr., 1921, *F. D. Patterson* (D); Baxter's Camp above Alta, on road to Truckee, May 13, 1924, *L. Austin* (D). Plumas Co.: Mill Cr., Sept., 1896, *R. M. Austin 542* (in part) (M, NY, US); 1853–4, *J. M. Bigelow* (G); Spanish Peak, June 29, 1912, *Hall 9294* (UC). Shasta Co.: Goose Valley, June 29, July 11, 1912, *Eastwood 947* (CA, US). Sierra Co.: Loyalton, Feather River, *J. W. Morrison* (P); 1874, *J. G. Lemmon* (G). Siskiyou Co.: Kidder Cr., Apr. 22, 1910, *G. D. Butler 1222* (UC); Quartz Valley, Apr. 27, 1909, *Butler 690* (D, UC); Marble Mt., June, 1901, *H. P. Chandler 1553* (UC); E. base of Mt. Eddy, June 7, 1941, *W. B. Cooke 16021* (D, NY); Shasta Springs on road to McCloud, May 27, 1923, *Eastwood 11941* (CA); Cecilville, S. Fork Salmon River, Apr. 27, 1929, *D. K. Kildale 7572* (D); Hilts, June 17, 1916, *M. Stonehouse* (CA). Tehama Co.: upper Deer Cr. Trail, June 24, 1912, *C. M. Wilder* (UC). Tulare Co.: Giant Forest, Aug., 1905, *K. Brandegee* (UC); Doyle's Soda Spring, region of Middle Tule River, July 26, 1895, *Dudley 903* (D); Redwood Canyon, Kaweah River Valley, July 24, 1896, *Dudley 1388* (D); Hollow Log Camp, July, 1900, *Dudley* (D); Board Camp Cr., June 28, 1902, *Dudley* (D); Sierra Nevada Mts., July, 1902, *Grant 290* (UM); Balch Park, May 30, 1936, *F. W. Peirson 11824* (CA). Tuolumne Co.: Crocker's, Aug. 4, 1907, *Eastwood 53* (CA); Carl Inn, on the W. Boundary of Yosemite National Forest, May 29, 1937, *R. C. Foster 306* (CA, G, M). Yuba Co.: Brownville, *L. V. Birmingham* (NY). OREGON. Coos Co.: Iron Mt., June 15, 1948, *W. H. Baker 5469* (OS); Myrtle Point, May 12, 1893, *G. A. Holzinger 33* (US). Curry Co.: Snow Camp to Snow Camp Lookout, June 24, 1929. *J. R. Leach 2398* (UO). Douglas Co.: Stage Road Pass, Pacific Highway, May 12, 1924, *L. R. Abrams & G. T. Benson 10452* (D);

foot of grade, 19.6 mi. W. of Roseburg on Marshfield road, May 13, 1924, *Abrams 10510* (D); Cow Cr. Canyon, May 9, 1922, *M. W. Gorman 5629* (WS); Glendale, June 19, 1902, *M. E. Jones* (P); Rogue-Umpqua Divide, 20 mi. W. of Crater Lake, July 31, 1916, *M. E. Peck 4069* (WU); Ninemile Mt., W. Fork Marial Trail, June 20, 1917, *Peck 4073* (WU); 5 mi. S. of Canyonville, May 20, 1948, *Peck 24782* (WU); near Myrtle Cr., Apr. 9, 1934, *J. W. Thompson 10177* (UW). JACKSON Co.: Carter Cr., 12 mi. S. of Ashland, May 30, 1895, *E. I. Applegate 732* (D, G, US); near the head of Sampson Cr., southeastern Jackson Co., June 1, 1895, *Applegate 732a* (D, UC); near head of Keene Cr., May 26, 1898, *Applegate 2307* (D, NY, US); Sykes Cr., June 28, 1892, *E. W. Hammond 392* (M); Wimer, Apr. 4, 1889, *Hammond 392a* (G, M); high hills 20 mi. E. of Medford, June, 1927, *J. H. Heckner 14497* (UW, WU); summit of Siskiyous, near Inn, June 11, 1930, *Henderson 12929* (UO); Rogue River, near Woodville, June 27, 1909, *Peck 4068* (WU); canyon of Wagner Cr., May 23, 1948, *Peck 24875* (WU). JOSEPHINE Co.: upper Thompson Cr., May 10, 1924, *Abrams 10290* (D, RM); Butcherknife Cr. near confluence with Slate Cr., Apr. 13, 1925, *Applegate 4227* (D); Big Meadow, Lake Mt. Trail, Oregon Caves National Monument, June 20, 1935, *Applegate 9661* (in part) (D); near top of ridge E. of the Oregon Caves, June 20, 1935, *Applegate 9661* (in part) (D); Alta, May 17, (?), 1887, *Henderson* (G); along Redwood Highway near Selma, Apr. 1, 1926, *Henderson 5782* (CA, D, M, RM, UO); opposite Alameda Mine, Rogue River below Galice, Apr. 18, 1926, *Henderson 7208* (UO); by mountain streams near Waldo, Apr., 1887, *Howell* (M, NY, OS, UW, US); Grants Pass, Apr., 1912, *H. S. Prescott 3170* (WU); Kerby Peak, May 23, 1923, *A. R. Sweetser* (UO).

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